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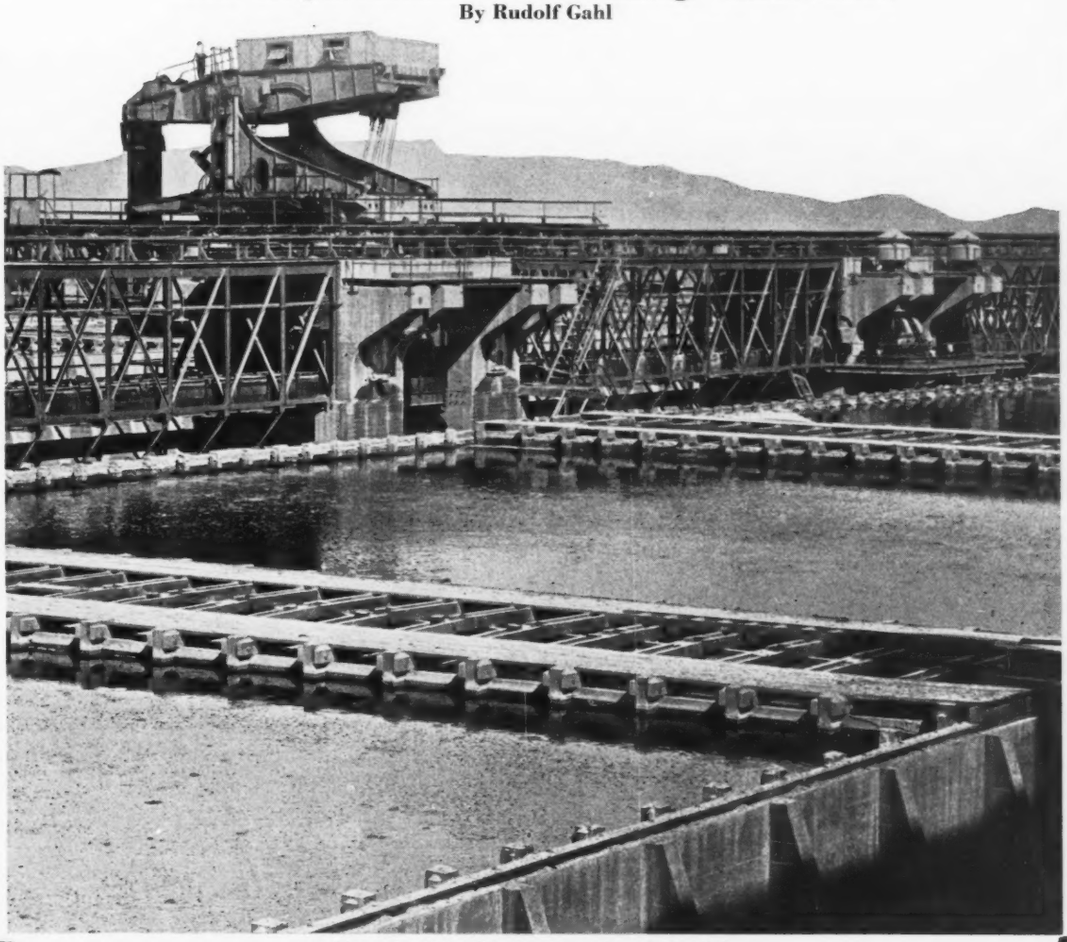

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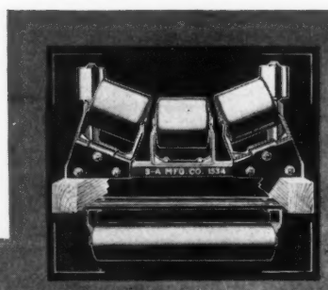

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Volume 113 | New York, June 3, 1922 | *Number* 22

Deep Veins

IT WAS POINTED OUT in an editorial last week that the rich shallow-formed Tertiary ores of the "bonanza" type have an always determinable limited vertical range, below which will be found barren veins or even barren fissures; nevertheless, other vein types, which have formed at greater depths, have greater original vertical range, and hence greater possibilities (though not certainties) for deep mining. Near this opposite end of the classification, perhaps, stand gold-bearing veins of the deep type, associated with granitic, monzonitic, or sometimes dioritic intrusions. Such are the gold-quartz veins of California and of Ontario, for example. They represent older types of veins—in California, post-Jurassic; in Ontario, pre-Cambrian—and have been exposed through deep erosion. In California, at Grass Valley and on the Mother Lode, these veins are ore-bearing for thousands of feet—over a mile on the dip at the Kennedy mine; and there is as yet no indication where the lower limits of ore-deposition will be reached. The orebodies are naturally not continuous in these veins, any more than they are in the Tertiary veins; but beneath an exhausted orebody on the Mother Lode, deep exploration has repeatedly discovered other orebodies. Thence arose the unwarranted theory of the "barren zone." There is no certainty that new orebodies will be discovered in depth; there exists only the opportunity that may be afforded by an excellent prospecting chance.

The lower limit of ore-deposition, and of the total original vertical range, has not been determined. Whereas, the maximum possibility in the Tertiary veins appears to be perhaps three thousand feet, the corresponding possibility in the deep gold-quartz veins may well be double that amount, or more. It is this geologic condition that renders gold-mining still hopeful and attractive in California, and which offers hope for long life of gold mining in Ontario, as at Porcupine. Lack of perception of these differences in different types of veins, however, leads to unnecessary risks in exploration in depth: as, for example, in the case of such mines as El Oro, in Mexico, and the Camp Bird, in Colorado, and the Gold Roads, in Arizona—all of which properties may be considered as being of the Tertiary bonanza type.

It is, however, to be remarked that the deep quartz veins often degenerate, as in the Appalachian belt, and also at many places in the Canadian region, into a string of lenses, due to their deep origin. A lens opened up at the surface pinches at a little depth; and deeper exploration becomes speculative on account of the physical conditions. The chances of other ore-bearing lenses at greater depth are excellent; but whether it will pay to search for these, with the amount of dead-work entailed by the separation of the lenses, is a problem of mine management which obviously will depend on various factors that must be given consideration by those in charge of the enterprise.

Mineral Wealth and Self-Determination

THE DISCOVERY and development of mineral resources in an otherwise unproductive region seldom fails to result in an increasing evidence of patriotic fervor on the part of the inhabitants. In some instances the newly acquired love of native soil leads to a desire for independence, which may be embarrassing to others. Thus we learn that the preliminary discussion at Washington between representatives of Chile and Peru anent the Tacna-Arica controversy is likely to be rudely disturbed by the presence at the national capital of a delegation of gentlemen who call themselves native Tarapacans, and who intend to petition President Harding that the Treaty of Ancon, by which the Province of Tarapacá was ceded to Chile in 1881, be canceled.

The intervention, if taken seriously, introduces a new element into a controversy that has taxed the reasoning powers of all impartial observers. To appreciate the situation it is necessary to recall the fact that the nitrate deposits in South America were first exploited, developed, and financed in the (then) Peruvian province of Tarapacá by Chileans. The War of the Pacific arose in consequence of alleged illegalities on the part of Bolivia, particularly toward the Cia. de Salitres y Ferrocarril de Antofagasta, a Chilean company with headquarters in the coastal town of Antofagasta, which at that time belonged to Bolivia. Peru joined forces with Bolivia, and both were defeated. The Treaty of Ancon resulted in the permanent cession of all the valuable nitrate deposits to Chile, together with the temporary cession of Tacna and Arica, pending the result of a plebiscite to be held after ten years to determine the wishes of the inhabitants.

It is claimed that a few Peruvians, resident in Tarapacá immediately prior to the war, opposed the treaty. As to which side is to blame for the failure to hold the plebiscite, no one can speak with assurance unless he be a Chilean or a Peruvian. Suffice to say that Chile wants to retain hold of the buffer states, for they serve as a protection against sudden attack to regain the valuable nitrate deposits farther south. Peru, on the other hand, makes no secret of her desire to regain possession not only of the buffer states but also of Tarapacá and other nitrate districts.

To settle what for many years has been known as the Tacna-Arica controversy, a meeting of delegates of Chile and Peru was convened at Washington. Prospects of a settlement are hopeful, but the situation is now complicated by the news of the arrival of the natives of Tarapacá—the district that is the *casus belli* of the whole trouble. From press reports it would seem that these gentlemen apparently expect recognition as a separate group.

Tarapacá is one of the centers of the nitrate industry. The province is immensely rich in potential reserves of nitrate. Its wealth, absorbed by the Chilean government in the form of an export tax, has flowed in a

steady stream to the capital at Santiago, far to the south. There it has served to bolster the finances of the government to an extent that has permitted Chile to copy the German army and the British navy, and with remarkable success. Those directly concerned with development of the nitrate industry in the arid regions to the north have mourned the loss of so much good revenue to the national capital. This sentiment has now found an outlet by the so-called Tarapacans—they may be Chileans or they may be Peruvians—who appear to be under the impression that they may yet make Tarapacá and its revenues their own particular concern, with that simple and innocent and philosophic attitude that characterizes so many Latin Americans when the resources of their country have been developed by outside capital.

Chile, however, has no intention of relinquishing Tarapacá, The money received from the nitrate export tax is essential to the financial stability of the country. The Tarapacans must feel annoyed that a considerable portion of the wealth from the pampa has gone to build up a military establishment that serves as an insurance against secession or a return of the land to Peru.

It is to be hoped that an amicable agreement in regard to the Tacna-Arica controversy is imminent; the ending of the squabble will serve to draw further attention to Washington as the world's center for the burying of the hatchet. But we have good reason to believe that the native Tarapacans, whoever they are, are wasting their time. The United States can and will offer hospitality and good advice to disputants, but we predict that the President will be silent on so absurd a demand as one asking for the cancelation of a treaty made between two foreign countries in the early 80's.

What We Publish—A Straw Vote

WE HAVE HAD many individual opinions about our publication. We are this and that; the opinions are scattered, contradictory, and confusing. Journalism is service; but our clientele is very large. To get a representative straw vote, we sent out a questionnaire to about 300 subscribers, selected as representing a cross-section of the whole group. More than one in four responded; and we are very thankful for their trouble. It has enabled us to have a more representative mass of opinion, a helpful index of sentiment.

We first asked, "Have we the right proportion of technical articles?" There were 71 decided answers; 61 held that we had the right proportion; 6 held that we had too many; 4 that we had too few. We must conclude that our policy regarding the proportion of technical articles is fully approved.

Our second question was, "Have we the right proportion of descriptive articles?" Our correspondents voted thus: Forty-nine said the proportion was right; 11 held that we had too few; 2 that we had too many. We conclude that we can go even a little further with good descriptive articles without glutting the market.

Our third question was, "Have we the right proportion of articles on mining geology?" And 44 said we had the right proportion; but 19 said we had too few; only 2 said we had too many. Clearly, there is a certain appetite for good articles on practical mining geology not yet satisfied.

Fourth, we asked, "Do you approve of articles on economic subjects connected with mining?" The vote in the affirmative was practically unanimous; Yes, 64; No, 1. The economic phases of the mining industry are vital.

Well, there were a lot of other questions, and we may refer to the vote on them later. Enough for the present. We had also a lot of pleasant praise; and a very few jolts, all of which we consider attentively.

"In a general way I heartily approve of the general lay-out, and I am confident that it meets a great need in an excellent way." "I think the *Journal* in its present form is extremely satisfactory." "There is no need of my going over your questions singly, for I approve of each and every one of your departments individually and collectively." "I consider the *Journal* well-balanced in the subject-matter it publishes."

Our questionnaire, it may be explained, was necessarily based upon policy prior to the consolidation into the present *Journal-Press*.

Alchemy and the Transmutation of Elements

ALCHEMY, the dictionary tells us, was a medieval science, the principal objects of which were to transmute base metals into gold and to find a panacea and a means of prolonging life indefinitely. The word is of doubtful origin, but it is probable that it was used first to designate the art of extracting juices from herbs, in the manufacture of medicines. Later, as an authority has said, it represented "the sickly but imaginative infancy through which chemistry had to pass before it attained its majority"; it was shrouded with humbug and secrecy—two features that distinguish it from the real science of today.

In early times alchemy was intertwined with religion. Thus in the fourth century, A. D., Nemesium, Bishop of Emesa, is reported to have said that the Creator, in order to prevent the destruction of elements, had wisely ordained that they be capable of transmutation, the one into the other, or into their component parts, or that the component parts could be resolved into the original elements. "Thus," he said, "the perpetuity of things is secured by the continued succession of their respective generation."

It is probable that the first workers in this phase of chemistry began their investigations with honest motives; but an ignorance of the fundamentals of science soon forced them to stoop to trickery and fraud. One of the earliest experiments may have been to turn a piece of lead to an oxide ash, possessing none of the physical characteristics of the original metal. The ash might then be mixed with charcoal and heated in a crucible, and lead would again be produced. Such an experiment, to the credulous, would prove the transmutability of metals into other substances, or the transmutability of other substances into metals. Having thus gained, as an investigator of superior intelligence, the support of the people, the alchemist, to save his reputation, was obliged to tackle the insistent problem of the transmutation of a base metal into gold; and this was when the humbug began.

The fiction advanced at that time was that gold was the acme of purity, and that other substances could be transformed into it by merely removing the dross. Because of the fact that fire lent itself to the secrecy with which all such work was performed, it was

adopted as the principal agent for the removal of the "impurities" and the production of the coveted lucre. The heat necessary prevented a close examination by the onlookers of the details and progress of the experiment. Much cunning was shown by the alchemist; his "transmutations" would convince many at the present time were it not for the healthy influence of a science that knows no chicanery, and a recognition of the fact that science is truth.

The majority of the alchemists were entirely unscrupulous. They demonstrated that it was possible to change charcoal into silver by burning it; all that was needed was to soak the charcoal beforehand in a solution of some silver compound. To change charcoal into gold the alchemist would bore a small hole in the charcoal, fill it with gold dust and then plug the mouth of cavity so that it was impossible to detect that it had been tampered with. It was then smelted in a crucible; the charcoal was burnt, and a button of gold remained.

Another favorite experiment was designed to prove to the credulous that lead could be converted into gold by heat. The lead was melted in a crucible and stirred with an iron rod. This rod had previously been hollowed out for a short distance from the end, the cavity being filled with gold dust and plugged with paper. As soon as the rod came in contact with the molten lead, the paper burned and the precious metal mixed with the lead. The alloy would then be kept hot in a strong draft of air until all the lead had been oxidized, after which a button of gold would be found.

But, strange to relate, many a fiction serves to herald the truth; and now we learn that the element helium can be produced from the element radium, and that both uranium and thorium undergo slow change, with lead as the final product. Discoveries such as these revive hopes among the get-rich-quick section of the community that gold may be made artificially, and by human intervention, from lead or other base metal.

The gold-mining industry is no more likely to be affected by the progress of scientific research in the matter of the transmutation of metals than it was by the chicanery of the alchemists.

Developing the Would-Be Engineer

PRESIDENT JOHN GRIER HIBBEN of Princeton University, in discussing recently the education of an engineer, said that a man who is highly developed mentally but who lacks character is a menace to the community. On the other hand, one who has character without mind, he said, comes to grief in the contests and the conflicts of life. Future success and conspicuous leadership necessitate an early grasp of fundamental principles, rather than the mental acquisition of indigestible facts; the sciences must be mastered by every student of engineering.

These comments suggest a connection between character and science, which will become apparent on closer analysis; for character, essentially, is sincerity and truth. Science, on the other hand, is verity and thoroughness. The "early grasp of fundamental principles" necessitates something more than mere acquisitiveness; it demands the full use of reasoning power; it tasks the entire resources of the mind; it stimulates thought. Too small an amount of individual thinking is required of the average engineering student; little attempt is made usually to quicken and encourage the imagination. The full-fledged graduate emerges from his *Alma Mater* equipped with a university diploma, evidence of acceptance in the ranks of a so-called professional organization, and a number of facts and formulæ. If he forgets the facts or mislays the formulæ he is indeed lost, for his "education" has been handed to him in tabloid form, and he knows but little of the why and the wherefore. If he be wise he will make an early attempt to remedy a state of affairs that finds daily encouragement in so many of our schools of learning. He will admit, at the beginning, that he is not an engineer, whichever interpretation of the term be accepted. He will start to show a real acquisitiveness for the knowledge, not found in textbooks, that shows what others have done, on which to base his research, and by which he may add at least one small brick of originality to the edifice of knowledge. This will stimulate his imaginative powers; it will create an inventive spirit, by which the future will be opened as a vista of unbounded possibilities. Thus will he become an engineer, showing initiative and creative spirit, with which he can achieve what to the mediocrity appears impossible or impracticable.

Potential Energy, or Gold as a Backing for Paper Money

WE HAVE HEARD much of late about the "commodity dollar." The sequel to this is the proposal by Henry Ford that the undeveloped water-power resources of the South shall serve as a backing for paper currency to be issued to meet the cost of development. This comes as an alternative to the printing of fiat money, with no promise of redemption in any form; but whatever the zeal and sincerity that would-be economic reformers put behind proposals such as this, it is evident that the world knows full well the necessity for backing paper currency with something of tangible worth—something that will buy anything and everything in any mart in the world. Such backing may be in the form of specie in the vaults of the national banks, or it may exist in the mines, unrecovered but determinable as to approximate amount and purchasing power.

The argument that the United States is not in reality on a gold basis, because it could not at any one time redeem all the paper money in circulation, is specious, for it ignores the lack of necessity for such provision. The retention of so much gold, away from national and international circulation and use, would be an unjustifiable waste of resources. The fact that no unreasonable advantage is taken of the Government's promise to redeem in gold is an evidence of national stability and individual prosperity. It demonstrates the wisdom of existing provision in this respect.

Recent European history has shown that the nations which have issued paper money *ad libitum*, with no backing of real and international-trading value, are in the throes of economic and financial chaos, or they are slipping toward national bankruptcy. Some standard of value, some indication of financial stability, is necessary. To back paper currency on something so intangible as undeveloped water-power resources would presage a riot of irresponsible promotion. It would be as airy a scheme as the issuing of bonds against the atmosphere, the nitrogen content of which Mr. Ford hopes to utilize for the manufacture of fertilizer.

Conditions on the Rand

By T. A. Rickard

SINCE the ending of the strike that interrupted mining operations on the Rand and threatened a revolutionary war, the various forces that were engaged in that conflict are now correcting the disorder caused by the disturbance of normal economic health. The Government has shown vigor in prosecuting the smaller offenders, many of whom have been convicted by due process of law, whereas the leaders and those who murdered a group of employees at the Brakpan mine are being held under arrest, pending the collection of further evidence. The Chamber of Mines has announced its new policy and specified the conditions under which the trade-unions will be recognized in future. The most stringent conditions are that (1) the union must be truly representative; (2) provision for a secret ballot of members, before striking, must be made, (3) the members of the union must not refuse to work with non-union men, and (4) the unions must not be represented by persons recently associated with the South African Industrial Federation, or 'council of action', which, as will be recalled, was the organization primarily responsible for the recent outbreak of anarchistic violence, euphemistically termed a strike. The unions themselves—now pleading, defensive, and ashamed—are endeavoring wildly to test and to recover their strength after their recent costly failure, and after seeing the complete defeat of their allies, the communists and revolutionary nationalists.

The mine managers are rehabilitating their white-labor forces, to bring them into proportion with the number of native laborers remaining on the mines. During the strike 50,000 natives were repatriated, so the mines are much under-manned, but the managers are enjoying a free hand and a power to discriminate between white workers such as they have not found practicable for several years. American readers, who may have seen only the scanty accounts appearing in the daily press on the subject of the Rand strike and its sequel of revolution, may have had difficulty in gauging the magnitude of the economic and political upheaval, in comparison with similar disorders in our Western camps. In my recent article on the subject (in the issue of May 6) I tried to make clear how serious an event it was, so that my readers will know whether to measure it with a micrometer or a two-foot rule. The following statement of casualties, incurred chiefly at the Far East Rand mines and in the district immediately west of Johannesburg, is eloquent: government forces, killed 50, wounded 237; civilians (revolutionists and peaceful citizens), killed 136, wounded 287; colored persons, killed 31, wounded 67, total, killed 217, wounded 591.

The strikers originally involved numbered 22,000, of whom it may be estimated that 10,000 were voluntary and 12,000 involuntary participants in the affair. The majority of the men were afraid to vote against the strike or to assert themselves against the extremists. This is the story of most outbreaks of a similar kind; the quiet and conservative men are harried by the violent and radical members of the unions. The open vote plays into the hands of the extremists by intimidating those who are good citizens. If the Chamber of Mines can use the prestige acquired recently, in consequence of the defeat of the unions, to force them to use the secret ballot at their meetings, it will be a step toward giving strength to the better element in the unions. The idea of insisting that the unions be "truly representative" is good also, for the system of collective bargaining cannot be effective unless both sides are thoroughly representative. The system breaks down when the larger part of the employees decline to unionize, and especially if, as happens usually, the married men and the more orderly individuals stay out of the union, which then consists of the less responsible and more radical elements, to whom the system of collective bargaining, as expressed by unionization, becomes a means of making industrial trouble. The working-man's hatred of the 'scab'—the non-union man that accepts employment during a strike—is intelligible enough; and although non-union labor may serve as a convenient tool for breaking organized labor when it becomes tyrannical, it is evident to an onlooker that the system of collective bargaining must fail even during a peaceful period so long as it excludes a large number of those whose welfare it affects.

A committee has been appointed by the Minister of the Interior to investigate claims arising from damage done during the strike and to make compensation for injury to the person and property of peaceful citizens and of those who assisted the Government in suppressing the disturbance. General Smuts, during the debate on this subject in the Assembly, said that the commission to investigate recent strikes was "more necessary than ever, because, owing to the mine-owners' victory, there was danger that the employers would refuse to take into account the voice of organized labor". He stated also that the Government "could not countenance tyranny by either side". It is evident that the Premier is living up to his reputation for fairness and sagacity. Nevertheless the Opposition, headed by General Herzog, an irreconcilable Boer of the old type, has endeavored to exploit sundry incidents of the strike, more especially the declaration of martial law, against the Government. Public opinion, however, inside and outside the South African parliament supports the Premier in his efforts to resolve a difficult situation.

To the shareholders of the mining companies operating on the Rand the question of the moment is how far the demoralization of the mining industry during recent years is to be checked; to what degree the subordination of managerial authority and technical efficiency to the dictates of labor policies is to be corrected; and whether these sinister influences are now to prevent a speedy re-establishing of mining operations on a sound economic basis despite the decreasing assistance of the currency premium. The return to the mines of the Kaffirs that were repatriated will be a slow business, and when they re-start to work they may show signs of demoralization, owing to the interval of idleness, but, with pluck and sagacity in the right quarters, there should be no delay in restoring the technical efficiency and industrial vitality of the Rand.

DISCUSSION

Assisting Development of Prospects

Attempts to Increase Asking Price After Negotiations Have Been Initiated Often Result to Disadvantage of All Concerned—An Equitable Method of Reaching an Agreement

THE EDITOR:

Sir—The finding and development of prospects is our pressing need. The physical factors which influence the value of a prospect, such as geology and possible methods of mining and treatment of the ore, have been thoroughly discussed, but one of the most important phases of the question, and the least likely to receive a solution, is the human element entering in the development of prospects.

Usually our friend the prospector does a lot of work and endures many hardships without financial help. Eventually he needs someone to help him equip his property with machinery for further work or to extract the metals from the ore. When his funds are out and no one seems to want his property the valuation he sets on it is extremely low. But as soon as an outsider shows the slightest interest in his claim it is surprising to note the tremendous increase in its value.

No doubt others have had similar experiences as the following: Mr. X wanted some money to help develop his claim and offered a friend of mine a one-half interest for $3,500. I was asked to look up this prospect. The state and U. S. Geological surveys' reports regarding the district being favorable, I wrote Mr. X telling him that his claim seemed promising and that we wished to investigate it further. This was a fatal mistake, for in his next letter Mr. X wanted $10,000 cash for the same one-half interest. After a little correspondence Mr. X admitted that there had been no new discovery on his ground or any new excitement in the district since his original offer to sell. The fact that we showed an interest in his property was justification for his boosting of the price almost three times what he thought it was worth when he was trying to market it himself. As far as we were concerned the skyrocketting of the selling price by Mr. X ended the negotiations. I did not dare to think of the price had we shown enough interest to inspect the property.

This trait of getting all the traffic will bear is not inherent to the man who wants to sell his claim but also to the man who wants to finance further development and wants to "hog" the whole project or freeze out the original owners. The prospector is certainly entitled to a good share in the profits of the mine brought to life by his efforts, yet he should also consider that there are many other businesses in which a man can invest his money, and that the only thing which makes him willing to help the claim owner is the possibility of making a large profit.

During his work, day in and day out, and constantly pondering over his daily problems, our prospector is apt to become visionary. He feels sure that "she gets richer the further down you go." The thought of enormous wealth just ahead of his drift spurs him on. Consciously or not, he may stretch the value of his mineral in sight.

Briefly, Mr. Y's small mine had been closed some time for lack of funds. The most important part of the mine, the sulphide zone, has been allowed to fill with water. Mr. Y assured me that the dump, which he had carefully sampled and which represented his last work, averaged $7.50 per ton in gold. Being unable to sample the mine on account of water, we decided to sample the dump, and told Mr. Y to select for us his own sample of what he considered ore. Instead of the expected $7.50, later assays by a reliable assayer gave for our own sample $1.04 and Mr. Y's sample $0.54. Leaving aside the difficulty of getting a true sample of a dump, Mr. Y, although familiar with the district and this particular property, could not tell ore from country rock.

The point I wish to emphasize by this recital is the lack of precise information which many men seem to have concerning their property. This does not apply generally, of course, but a number seem to be afraid of knowing definitely the assay value, and prefer to rely entirely on their judgment and guess.

Mr. Z showed me some samples of copper ore. He knew he had copper because the water coming out of his tunnel would copper plate a shovel if left in long enough. Mr. Z had spent all summer working on his claims until driven off by the winter snows. He carried these specimens with him, and when asked how much copper they contained the answer was that he did not dare have assays made for fear of spoiling his mine.

The indefinite permits the mind to conjure dreams and fancies, but a successful mine is built on the hard foundation of metallic content of the ore.

But two things can be determined with some accuracy—the value of the exposed faces and their position on a map. Every engineer realizes the importance of even a rough assay map of the mine, kept right up to the minute during the development period. To know positively what you have and where it is gives the basis for further intelligent work. This map becomes of great value when the earlier workings have caved and become inaccessible, for verbal information regarding old workings becomes most unreliable and scarce as time goes on.

The two points I have tried to make are: First: That numerous worthy prospects would be developed if the financier and the prospector met on a reasonable basis and if each were willing to let the other have a fair share of the expected profits: Second, that a number of prospects and small mines as well can be developed more quickly and cheaply by substituting more exact technical methods for the "guess system."

Oakland, Cal. LOUIS J. BRUNEL.

Mining Industry's Share of the Government Burden

THE EDITOR:

Sir—The communication of C. B. Holmes in the April 22 issue, dealing with the problem of depletion, was most timely. All such communications for the last six years have been timely, and quite likely will be for the next decade, unless some such measures as he proposes are adopted. Depletion is the *monstrum horrendum, informe, ingens* which has been stalking the industry for the past half decade. It is at present the Great Unknown in the puzzled mind of the investor or engineer who still clings to the business of mining.

The unsettled claims for several years still outnumber those settled, in the files of the Revenue Bureau. Those that have been cleared away have been resolved by a compromise guess between the Natural Resources Bureau and the taxpayer. Company treasuries and the bank accounts of mining investors are still the repositories of inert funds which should be hunting out new orebodies and building new mills. The Government can do one thing, at least, while claiming that its paramount interest is the revival of industry, and that is to straighten out long-due settlements. The problem does not admit, though, quite such a dramatic and sweeping solution as Mr. Holmes advances—a uniform depletion factor for each product. It savors somewhat of emptying all the bottles on a laboratory shelf into a beaker to get a certain reagent.

All cases are different and must be separately considered, but as quickly as possible. More power to the appraisers (among whom are fortunately a few engineers), less tolerance of windy "agents" in Washington, and no consideration of involved and suspiciously refined accounting methods. These measures, vigorously applied, ought to clear out the files in a reasonable time.

Some such plan must be adopted for immediate relief. But the industry ought not to let it go at that. Corporation income taxes and depletion ought to be divorced. They ought never to have been joined. An income tax should levy upon wealth created by the energies of man, and it does in every other business but mining or a natural-resource development. The state has had, since the beginning of history, the power and the right to command the services of its people for war or public works. It allowed, later, the substitution of goods, and then money. Theoretically, the state, which has almost universally alienated its ownership of the soil, has the right to say—to collect its tithe of human energy—"so much of your wealth comes from the ground, and so much from your labor. Our slice comes from the latter."

In practice, as we have learned in the past six years, such an attempt is so complicated as to be absurd. Least of all minds is the collective lawyer-mind of Congress capable of doing this. What it can do, pretty well, is to arrange it so that mining bears its proportionate share, neither more nor less, of the burden of government, in comparison with the other industries. A lawyer, whose training and mental habit would make him the inferior of an engineer in working out the complex applications of depletion, is often the latter's superior as an arbitrator and adjustor. The mining industry must, of course, present its side vigorously and clearly, with emphasis on the inherently hazardous nature of the pursuit.

Depletion, moreover, is a matter which might well concern not the impersonal corporation but the stockholder as an individual. It is simply a device to guide him in keeping his possessions intact, although his mine is decreasing in value, by careful reinvestment. Before this application to the tax law arose, it was recognized as such. Mr. Holmes says: "In years prior to 1913 no one had ever seen a depletion account on mining books." This was because a stockholder was supposed to look after his own re-investments. The reports of the companies were his sources of information as to how fast his capital was disappearing. Although he did not see, perhaps, the problem in all its details, he went out and looked for a new mine, or bought some bonds. The income-tax law took this matter out of his hands, where it belonged.

The analytical appraisal method, based on money rates, was applied to mining in the early days of the Rand. In 1897 a paper in the *Transactions* of the Institution of Mining and Metallurgy dealt with it exhaustively. Once applied to determine the fair purchase price, it was dropped; the investor could use it or not, as he wished, in splitting his dividends into income and return of principal. I hope, of course, that the reader has in mind the distinction between depreciation charges (amortization) which are proper on the books of the corporation, and depletion.

All of which, the whole of this letter, might have been expressed succinctly by: "Behold the Canadian mining tax laws." In Ontario there is a flat exemption for small earnings, a flat rate for earnings between certain limits, a higher fixed rate between higher limits, and so on, and no "depletion" deductions allowed. The dominion and the provinces thus determine the mining industry's proportion of the government burden. If it has been excessive or unfair, you will have a hard time explaining the northward flow of American capital. The need of the United States is for such a measure, and the scrapping of present regulations and procedure.

New York City. RUSSELL H. BENNETT.

Efficiency in the Use of Safety Fuse

THE EDITOR:

Sir—It was with considerable interest that I read Mr. Tillson's article, "Promoting Efficiency in Drilling and Blasting," which appeared in the March 18 issue of *Engineering and Mining Journal;* but I do feel that in justice to the men who have to use safety fuse in the mines, it would be well to call their attention to certain errors that unwittingly have crept into Mr. Tillson's paper.

Mr. Tillson will probably acknowledge that through error he has stated the opposite to what he intended when he says, "Fuse burns slower when the gases of combustion are confined." The statement should read, "Fuse burns faster when the gases of combustion are confined." This is obvious when one considers the reason. If the gases generated by burning cannot escape readily, they build up a pressure within the fuse which forces the flame ahead faster. A simple test to illustrate the point can be conducted by burning a piece of fuse while holding it tight in the jaws of a vise. It seems to me, therefore, that Mr. Tillson's statement is misleading, and dangerous to miners if they act on his theory.

Certain field investigation on complaints regarding safety fuse have led to one or two interesting and well-

established facts. It has been found that the reason why fuse fired holes out of rotation was that some holes in a round were tamped and some were not. The average miner, when loading a round of holes in development work, and realizing that the lifters are the last holes to shoot, usually places the primer in these holes reasonably close to the point of the hole, and tamps these holes exceptionally well, in order to exclude water and to protect the powder in these particular holes from the water that seeps in while the rest of the round is being shot.

It has been found that the lifting hole was usually the hole in which the fuse burned with the greatest rapidity when this method of loading was followed. The lifters in this case fired very much out of rotation and lessened the efficiency of the round to a marked degree. It has been found through careful investigation that the reason the fuse burned so much more rapidly in these holes than it did in the other holes in the same round was the fact that a greater length of fuse in the lifter was exposed to pressure. In other words, fuse on which pressure is exerted burns more rapidly than fuse which is untamped.

The same theory holds true regarding fuse burned at a considerable elevation above sea level, but under these conditions there is a relief of pressure and a slowing down in speed. The factory with which I am connected manufacturers fuse at an elevation of approximately 500 ft. above sea level. Fuse which burned at approximately forty seconds per foot in the open air, unconfined, at this elevation, when taken to an elevation of 7,000 ft. burned in the open, unconfined, at approximately fifty-six to sixty seconds per foot, and when returned to the point of manufacture burned at the original speed which it had when tested prior to leaving the plant. This is further illustrated by the following tests made with a certain brand of fuse in South America:

Place	Elevation, in Feet Above Sea Level	Burning Speed of Fuse, Seconds Per Yard
Lima, Peru	500	127
Chosica, Peru	2,800	136
San Bartolome, Peru	5,000	136
Matucana, Peru	7,800	141
Caspalca, Peru	13,600	158
Cerro de Pasco, Peru	14,200	158
Morococha, Peru	15,000	158
Ticlio, Peru	15,600	160

This feature of the effect of pressure on fuse was gone into thoroughly some years ago by two engineers at the testing station of the Bureau of Mines, Pittsburgh, Pa. The department issued an interesting pamphlet as a result of its work. (See Technical Paper No. 6, by Snelling and Cope.)

So far as I know, the requirements of governments, both in Europe and America, permit a variation of 10 per cent in speed either way from standard. These limits, which may at first consideration seem rather wide, are given the manufacturers not because it is impossible to make fuse which, within a given unit of manufacture, will burn at much closer limits, but because it is realized that fuse in commercial use is manufactured over an extended period and so under varying weather conditions; and it is, therefore, impracticable to establish closer factory limits without materially increasing the price at which the fuse reaches the consumer. The fuse manufacturers, however, realize full well the work which their product is supposed to perform, and throw around the manufacturing process of their fuse such practical and technical safeguards as will insure its burning as near the standard of their factories as possible. As an evidence of this care, it has been found, by a careful tabulation made by some of the largest copper minjng companies in the West, that it is not an unusual thing for their records to show a total of less than 0.5 per cent of missed holes from all causes over a period of many months, and they do not consider such a record as being at all unusual.

In conclusion, my experience of twelve years of investigating fuse complaints has let me to the belief that safety fuse fails to perform the function for which it is manufactured much more often as a result of abuse in transportation, storage, and handling than it does from any defect in manufacture.

Livermore, Cal. GRANT H. TOD.

Recognition of Mexico

THE EDITOR:

Sir—Your editorial in the issue of April 15 was timely and of great interest. Regarding Article 27 of the Constitution of 1917, perhaps too much stress is laid on its application to the petroleum industry, and too little to its being a subject of concern to Americans who have invested their savings in ranch lands here and in mortgage bank bonds secured by loans on ranch lands.

I refer to ranch lands acquired from their legitimate owners prior to 1917. As you know, mining men hanker to own a farm (where there is no work to do!), and some of us have used that method of investing for "an old-age stake." "PRO BONO AMERICANO."

Mexico.

Differential Flotation in Tasmania

The Electrolytic Zinc Co. has recently been carrying on some successful flotation experiments on the Read-Rosebery ores at Zeehan, Tasmania, according to *Chemical Engineering and Mining Review.*

A standard one-box Minerals Separation machine is used, and 200 to 300 lb. of ore is treated in one shift. The charge is fed in by buckets, after having been broken in a crusher and ground in a ball mill. The water is kept at a temperature of 120 deg. F. Sulphuric acid is introduced in sufficient amount to keep the liquid slightly acid—0.06 per cent. Wood tar oil with a little eucalyptus oil is added intermittently. Sulphur dioxide is introduced through the same pipe as the oil, from a small burner, keeping the solution saturated with the gas at a temperature of 120 deg. F. In this stage, a pyrite galena float is obtained. The sulphur dioxide has the effect of allowing the particles of blende to be wetted, and consequently they sink with the gangue.

When this float is finished, the temperature is raised to 140 deg. F., and the sulphur dioxide turned off. A mixture of coal tar and creosote, with a little eucalyptus oil, is added, and more acid from time to time to keep the liquid at 0.06 per cent throughout the run. When the sulphur dioxide has been expelled, the zinc sulphide froth rises and overflows.

The average metal content of the different products shows the result of the experiments to be:

	Zinc Per Cent	Lead Per Cent	Iron Per Cent
Feed	32	10	12
Pyrite-galena float	12	21	30
Zinc-concentrate float	55	5	5
Tailing or reject	4	3	2

A recovery of 85 per cent is obtained.

Ajo Enterprise of the New Cornelia Copper Co.—I

Ore Deposit First Opened by Spaniards in Eighteenth Century—Several Metallurgical Processes Proved Failures—Water Supply and Other Public Improvements Necessary—Ore Occurs as a Large Laccolith of Monzonite—Porphyry Oxidized Above Present Water Level

By A. W. Allen
Assistant Editor, *Engineering and Mining Journal-Press*

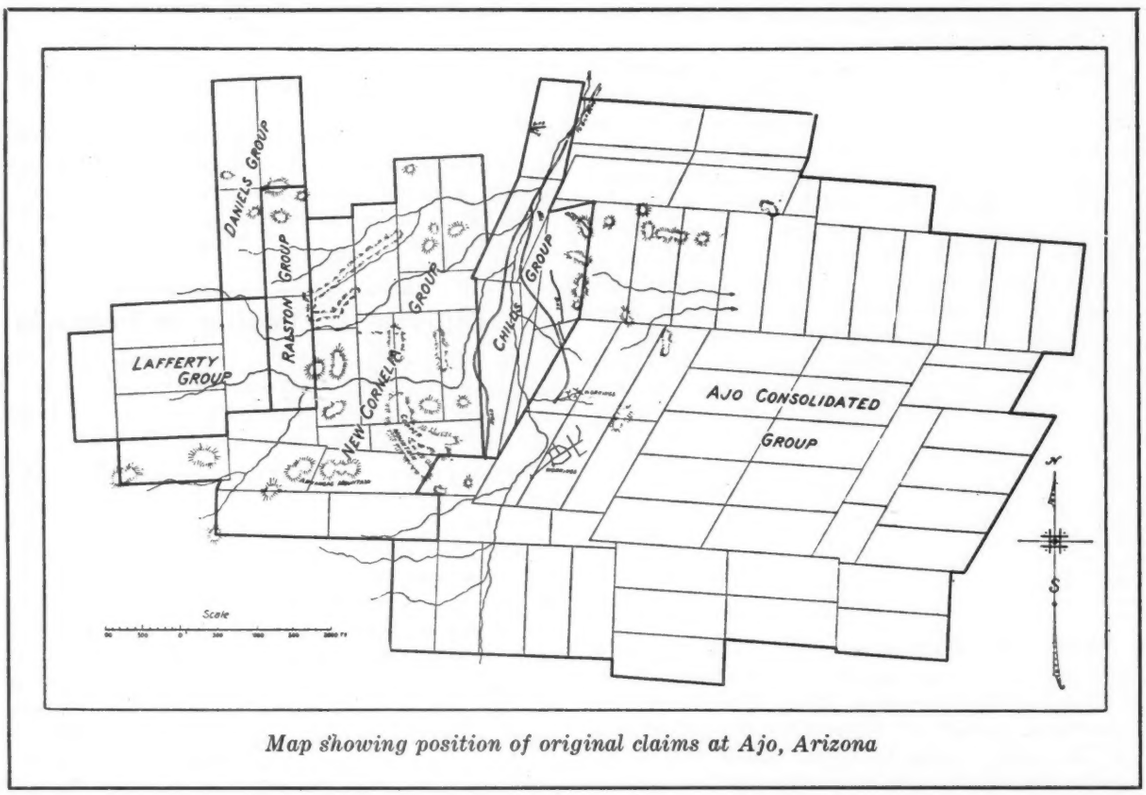
"WEST of the Santa Cruz, and south of the valley of the Gila, to the Colorado River, the territory is generally an irreclaimable desert. Its mountains abound in the precious metals, and a sufficiency of water for mining operations can be usually obtained without exorbitant expense. The celebrated Ajo mine, now known as the Arizona Copper Mine, is in this district. Mr. E. Dunbar . . . was formerly the director of this mine, and the first, I believe, to demonstrate the fact that water could be obtained . . . The Arizona mine will one day prove of immense value; like the rest of the mining companies, it needs the outlet on the Gulf of California."

So spoke one Sylvester Mowry before the American Geographical and Statistical Society in New York on Feb. 3, 1859. His prediction as to the future of the Ajo mine has been fulfilled, although the goal was reached only after many vicissitudes, in which personality and conviction, and the influence of such characteristics on others, played no small part.

Mines First Worked by Spaniards

The quotation shows that the district was looked upon with favor sixty years ago; in addition, it had something of a history even at that date, for the mines were said to have been opened by the Mexicans and the Spaniards a hundred years before.

Soon after the Gadsden Purchase, when that part of Mexico became United States territory in 1852, Arizona's first copper smelter, made of adobe brick, was built at Ajo, being operated by P. R. Brady and associates, who together formed a group of adventurers known as the Arizona Mining & Trading Co., with headquarters at Los Angeles. It is known that ore was shipped to San Francisco and to Swansea about that time, but the cost of production and the difficulties of transportation were such that the venture soon came to an ignominious end.



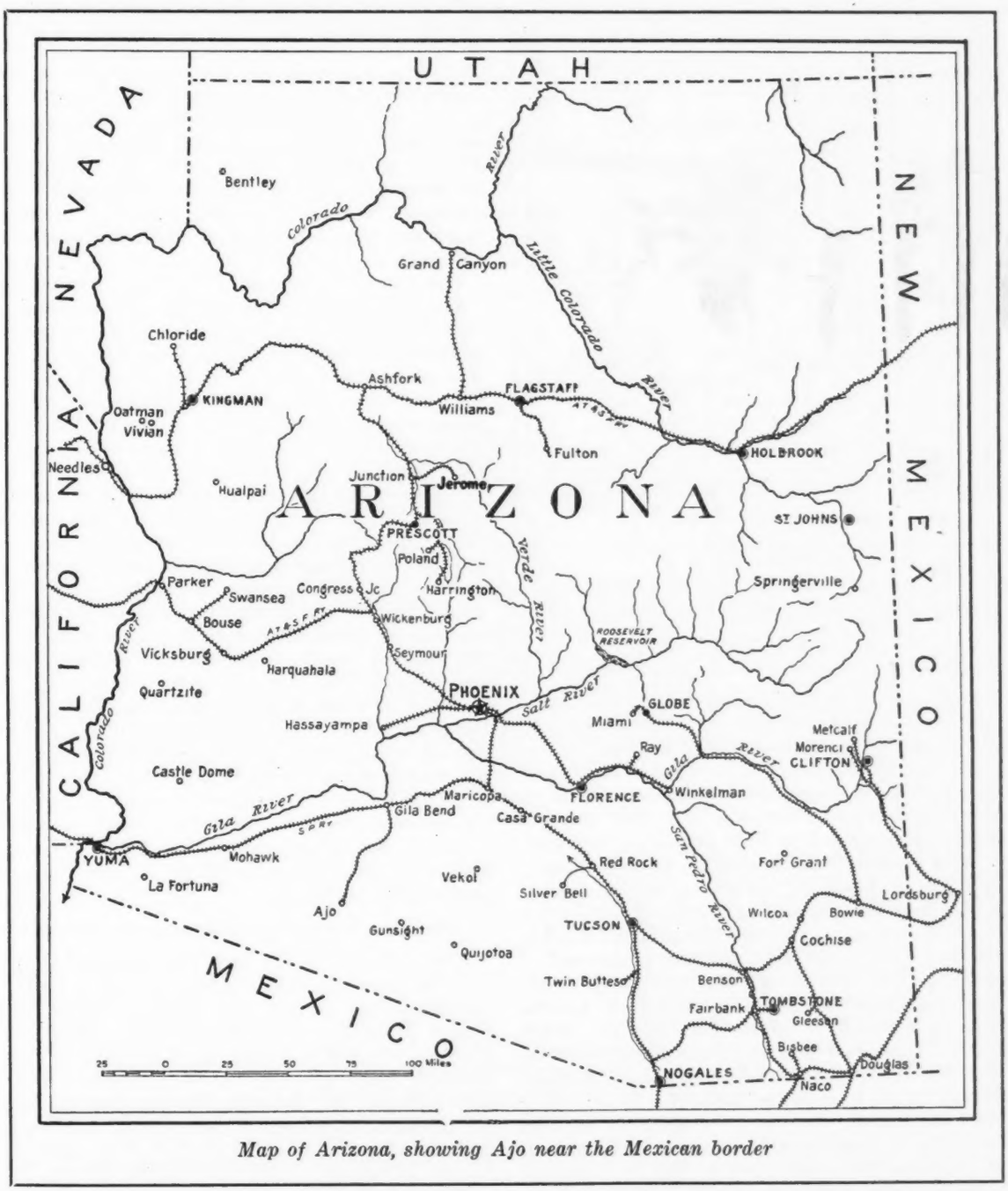
Map showing position of original claims at Ajo, Arizona

Exploitation Resumed in 1906

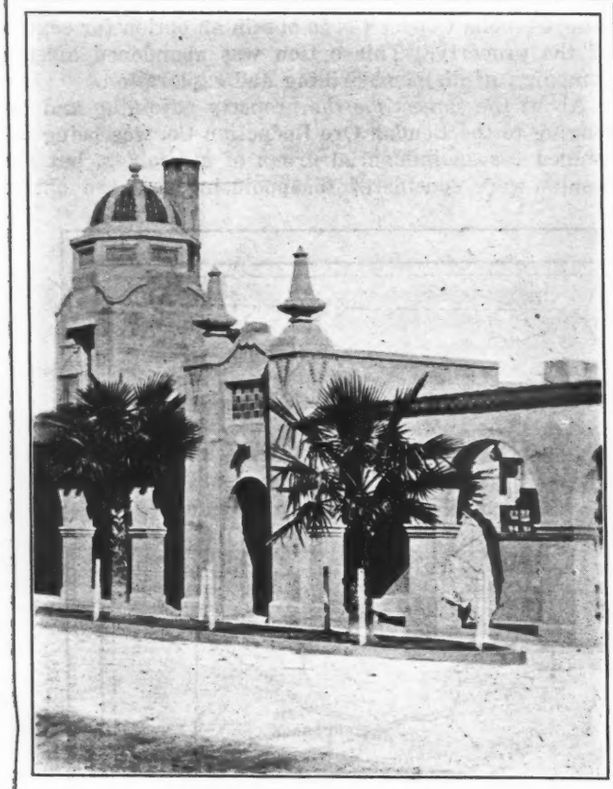
The district remained more or less dormant until early in the present century. A stamp mill and concentrating tables were in operation in 1906, some mines being held at that time under bond and lease by the promoters of a San Francisco enterprise known as the Ajo Copper Mountain Mines Co. Numerous reorganizations about that time resulted in the formation of two other companies, the Rendall Ore Reduction Co. and the Cornelia Copper Co. This original Cornelia company attempted to treat the ore by a fantastic patent process, in the

McGahan vacuum smelter, as it was called. The experiment, although sponsored by well-meaning individuals, was doomed to failure. The plant at Ajo cost about $30,000 and proved, as might be expected, a fizzle. The Anderson process of leaching with hydrofluosilicic acid was tried afterward and abandoned by the same company, whose estimate of ore reserves, it is interesting to note, was 25,000,000 tons containing an average of 10 per cent copper. Contemporaneously, the Ore Reduction company adopted the so-called Rendall process, by which, according to a contemporary record, could be treated with equal facility all classes of copper ores, at a cost of $1 per ton and with an extraction of 95 to 98 per cent. This venture, also doomed to metallurgic failure, was followed by another period of depressing quiescence, which was terminated when the General Development Co. purchased sufficient shares in the original New Cornelia Copper Co. to obtain an option for control of the property. This option was abandoned after a campaign of diamond drilling and exploration.

About the same time the property adjoining and belonging to the Rendall Ore Reduction Co. was being examined for an influential group of capitalists, but the results were considered disappointing and the option was allowed to lapse. In 1911 the Calumet & Arizona Mining Co. took an interest in the New Cornelia property, and an option on 76 per cent of the company's stock was acquired. From that time until the present the history of Ajo has been one of continued success, economic as well as metallurgic; and this has been due, in no small measure, to the sterling character and the technical ability of the men at the head of affairs, of



Map of Arizona, showing Ajo near the Mexican border



Railway station at Ajo

whom Dr. L. D. Ricketts and Captain (afterward Colonel and now General) John C. Greenway have been prominent.

Recent Development of the Ajo Deposit

A vigorous campaign of diamond drilling disclosed a large body of low-grade copper ore. Concurrently, the property owned by the Rendall Ore Reduction Co. was being examined by a group of engineers and capitalists, operating as the Ajo Consolidated Copper Co. Between the Ajo Consolidated claims and the New Cornelia claims lay the holdings that were known as the Childs group. This property was examined by engineers representing the U. S. Smelting, Refining & Mining Co., the option obtained, however, being forfeited soon afterward. In the meantime the Ajo Consolidated Co. had acquired the Rendall property and had progressed in developing the mine, which was then taken over by the New Cornelia Copper Co., as the Calumet & Arizona subsidiary was named, in 1917. This company, which replaced the Cornelia Copper Co., was incorporated in 1909 with a capital of $9,000,000, in $5 shares, of which the parent company controlled 1,229,741.

In 1915 the company increased its capital by an issue of $4,000,000, in 6 per cent twelve-year, sinking-fund gold bonds, convertible into stock at $10 per share, of which the Calumet & Arizona company subscribed for $3,100,000 at par. An initial dividend of 25c. per share was paid in November, 1918, amounting to $450,000, followed by others that totaled $900,000 in 1920. Since then the state of the copper market and excessive taxation have militated against regular disbursements of a similar nature, but these doubtless will be resumed when general economic conditions are normal. The property of the company now consists of sixty-two patented and ninety unpatented claims, and one patented millsite and fourteen unpatented millsites, covering an area of 2,854 acres.

Geographic Position of the Property

Ajo is situated in Pima County, Ariz., about forty-three miles from Gila Bend, a station on the Southern Pacific, and about midway between Tucson and Yuma. The Mexican border is but thirty miles distant; and rail connection with the Gulf of California, ninety-seven miles to the west, will provide an outlet to the sea. This, in conjunction with the provision of an adequate supply of power at reasonable rates—by utilizing the water-power of the Colorado River—will do much toward furthering the general prosperity of the Southwest. The branch railway from Gila Bend to Ajo, known as the Tucson, Cornelia & Gila Bend R.R., was completed in February, 1916. This was an enterprise that was undertaken jointly by the New Cornelia Copper Co. and the El Paso & Southwestern R.R.

Ajo is a veritable oasis in the desert; it has none of the undesirable characteristics of most Western mining towns. The climate for the greater part of the year is unusually pleasant and bracing; the rainfall in the district is among the lowest in the United States; cloudy days are rare. An annual precipitation of only a few inches is usual, so that vegetation is scanty, and the surroundings therefore are not altogether pleasing to the eye. However, the limitation of natural provision in this respect was appreciated early, and steps were taken to insure a water supply that would permit mining and metallurgical operations on an ambitious scale, would provide for the enormous evaporation from the surface of immense leaching vats, and would secure for the town and its inhabitants that supply of good water which is so essential to modern progress and comfort. The nearest supply in quantity is found in the Gila River, about fifty miles away; but a nearer source was essential, so a site was selected about eight miles from the property, a well was sunk about 700 ft., and a modern motor-driven pump was installed. A ten-in. pipeline carries about a million gallons of water per day to Ajo; and thus it is that one of the most pleasing sights on reaching the little township is the verdant plaza alongside the railway station, in which trees and well-kept grass lawns serve to relieve the monotony of the surrounding landscape.

Providing Creature Comforts for Residents

The buildings of Ajo have been designed in Mission style and are undeniably attractive and artistic. The railway station adjoins the business section and the houses of staff employees. A large school building stands at the end of an avenue of cactus; and a modern hospital, with beds for thirty-five patients, is perched on a hill near by. Between the town and the mine are the Mexican quarters, of one-, two-, and six-family houses, attractive alike both for their neatness and variety of design.

For the acquisition of creature comforts and necessaries the employees of the company have not been left entirely to the mercy of local tradesmen. A trading concern was formed at an early date by the New Cornelia Copper Co., and capital was advanced with which to build and equip a suitable general store for the benefit of employees. This is under the control of the company; but, by co-operation between the manager of the store and representatives of employees, the results are satis-

factory to all concerned. Surplus profits are distributed among those employees who have been with the company for at least four months, the following distributions having been made to date:

1917	(9 months)	$12,052.60 to 472 employees
1918		32,777.71 to 773 employees
1919		40,825.05 to 618 employees
1920		42,998.16 to 535 employees
1921		11,830.55 to 330 employees

The average refund to those who have made purchases at the store amounts to about 15 per cent.

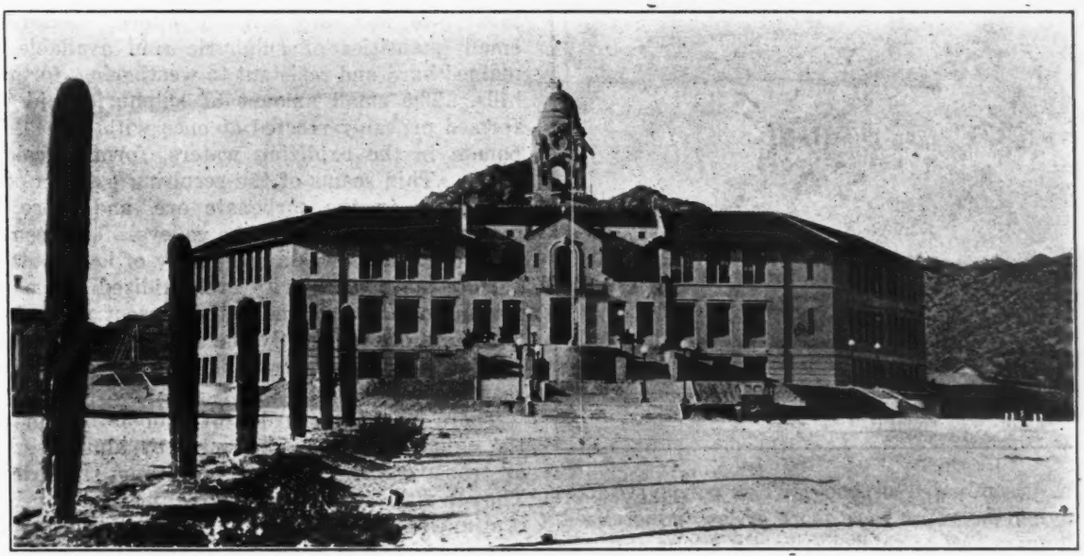
Geology of the Ajo Deposit

The geology of the deposit was described[1] in 1914 by Ira B. Joralemon, then geologist and now assistant general manager on the staff of the Calumet & Arizona Mining Co., the parent enterprise. His conclusions may be taken as authoritative, particularly because no differences of opinion have developed since they were first published. From this account it is learned that the most important feature of the geologic structure is the large laccolith of monzonite-porphyry, which uplifted the older rhyolite beds to form a dome. The crest of the dome was eroded at a comparatively recent time. This porphyry mass is eight or ten miles long by one to four miles wide, with the long axis extending N. 20 deg. W. The northern part of the intrusion forms high and rocky hills north of the Ajo basin. The southern end forms Copper Mountain, in the center of the basin. The copper deposit occurs in this southern part of the monzonite, where the axis of the laccolith is plunging to the southeast beneath the rhyolite.

On top of Copper Mountain the small remnants of rhyolite lie fairly flat; on the west flank of the intrusion the dip of the rhyolite is steeply to the southwest, the bends on the east flank dipping to the southeast at an angle of about 20 deg. The pitch to the south of the domed rhyolite beds is fairly steep; all the contacts are irregular. Copper Mountain and the Ajo basin surrounding it are thus formed by the monzonite and by the contact beds of rhyolite. To the east and to the west of the basin are hills of rhyolite lava, breccia, and tuff, with flat-lying beds of andesite lava and basalt in the distance, usually beyond gravel-filled valleys. South of the basin a large body of the red-brown conglomerate stretches away to the dark andesite and basalt mass of Black Mountain.

There are many inclusions of rhyolite within the monzonite, and dikes or irregular intrusions of monzonite break through the rhyolite, especially east of the Copper Mountain. Diorite or diabase dikes cut both monzonite and rhyolite, but apparently have had no important effect on the structure or the mineralization. Both the monzonite and the rhyolite near it are thoroughly shattered by fractures, which run in all directions. Some of these fractures are accompanied by considerable gouge, and may be faults of importance, but most of them can be traced for only a short distance, and are probably fissures of contraction.

The genesis and the history of the Ajo ore, according to Mr. Joralemon, have been easy to trace. After the monzonite intrusion had uplifted the rhyolite, the slow cooling of the porphyry was accompanied by considerable contraction. This resulted in a thorough jointing and fissuring of the monzonite, especially near the rhyolite contact, and in a less complete fracturing of the rhyolite itself. Near the center of the intrusion some of the fissures continued to a great depth. Probably soon after the solidification of the outer layer of porphyry, hot mineral-bearing solutions rose along these deep fractures; these solutions were charged heavily with iron, sulphur, silica, and, later, copper. The iron and the sulphur were carried through the joints and fissures of the rock far from the source of the mineralization, and caused a general though scanty pyritization of the monzonite mass; this pyritization was heaviest in the eastern part of the intrusion. Later, as the proportion of the silica and copper in the solutions increased, these solutions rose through the larger fractures in the monzonite until they encountered the impervious and less thoroughly fractured beds of overlying rhyolite. These dome-shaped beds acted as a dam, stopping the upward flow of the mineralizing solutions and causing them to spread out through the jointed monzonite on both sides of the large and deep-seated



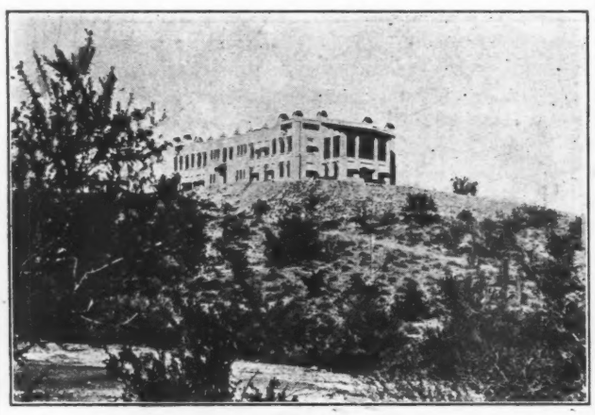
School at Ajo

[1] *Trans. A. I. M. E.*, Vol. 49, p. 598.

fractures. Here they remained imprisoned until they gave up their mineral content, depositing veins of quartz, chalcopyrite, and bornite along the fissures and joint-planes, and partly replacing the rock itself with the same minerals. The mineralization was greatest near the large central fractures through which the solutions had risen, and in the more thoroughly jointed portions of the monzonite near rhyolite contacts. In this manner was formed the mushroom-shaped disseminated orebody, grading on the sides and bottom to rock less thoroughly mineralized, or mineralized with iron instead of with copper sulphides.

Fracture and Erosion of the Deposit

Some of the larger fractures, usually accompanied by monzonite dikes, extended for a considerable distance up into the rhyolite. Along these fractures, it is maintained, the rich bornite veins in rhyolite were deposited, sometimes extending a long distance from



Hospital at Ajo

the large disseminated orebody. The porphyry dikes accompanying the veins were more or less mineralized, and small quantities of chalcopyrite, bornite, and pyrite were deposited in the rhyolite walls of the veins. Probably soon after the end of the period of mineralization, before the rhyolite cap of the ore had been eroded, the whole country was covered by a great thickness of andesitic lava and basalt. This covering protected the ore from surficial alteration until the present geologic period. Erosion in early Quaternary times must have been rapid. Deep canyons were cut in the recent lavas; the covering was stripped from the Ajo monzonite, and much of the orebody itself was washed away; the erosion was so rapid that oxidation did not keep pace with it. The copper in the ore that was eroded was left in the rock fragments washed down the hillsides or was carried off by the surficial drainage. The detritus from the eroded part of the orebody filled the canyons and valleys that had been cut in the lava east and south of Ajo. Part of the detritus was cemented into the hard ferruginous conglomerate by surface water that flowed over the pyritic porphyry east of the ore, and had taken into solution some of the iron of the oxidized pyrite. Boulders of oxidized ore remain scattered through the conglomerate and through the valley wash or gravel for several miles from Ajo.

Mr. Joralemon concludes by stating that, following this period of rapid erosion, stable conditions have lasted to the present time. The water level has remained nearly stationary, at a shallow depth, long enough to allow a thorough oxidation of the rock to this level. Where the mineralization was chiefly with pyrite, much sulphuric acid was formed by the oxidation of the pyrite to limonite. This acid thoroughly softened and kaolinized the feldspars of the monzonite, and helped to take into solution the copper from the traces of chalcopyrite that accompanied the pyrite. The copper was carried down by the descending surface waters, and was redeposited at water level to form the thin layer of chalcocite ore.

In the siliceous chalcopyrite and bornite orebody, it seems that little sulphuric acid was formed during the oxidation; the descending surface water, probably always small in amount in that arid climate, contained an excess of lime and of carbonic acid. The result of this was that, as soon as the copper sulphides were oxidized, the copper was precipitated almost in place, in the form of malachite and other oxide minerals. The iron of the chalcopyrite and bornite remained in place in the form of limonite and hematite. The silicified monzonite was only slightly altered, because of the small quantities of sulphuric acid available, and remained hard and resistant to weathering, forming steep hills. The small amount of sulphuric acid that was formed probably reacted at once with the calcium carbonate in the oxidizing waters, forming calcium sulphate. Thin seams of the resulting gypsum occur here and there in the carbonate ore, and there is much gypsum in the gravel of the valleys. The result of this cycle of changes was a large body of low-grade primary bornite and chalcopyrite ore, oxidized above a rolling nearly horizontal plane at the present water level, to a malachite ore of exactly the same grade as that of the sulphides. The ore was deposited from rising deep-seated solutions.

There is no overburden of lean or barren rock, for the oxidation was accompanied by almost no leaching or transportation of the copper from the primary ore. The ore rises above the surrounding barren ground, and continues without any considerable increase or decrease in copper content from the surface to the body of the orebody.

To be continued

Acetylene as a Precipitant for Cyanide Solutions

Acetylene has recently been investigated as a gold and silver precipitant from cyanide solutions.

The acetylene used in the tests, according to Serial No. 2346, *Reports of Investigations*, Bureau of Mines, was made from a commercial calcium carbide. A number of experiments resulted in more or less complete precipitation of silver, but in none of the experiments was gold precipitated.

As silver acetylide, obtained by precipitating the silver from an ammoniacal solution of silver nitrate by acetylene, is yellowish white, easily soluble in cyanide and highly explosive, and the precipitate obtained from the cyanide solutions was black, not soluble in cyanide and not explosive, it was decided to investigate the nature of the silver precipitate from the cyanide solutions. In preparing a large quantity of the precipitate it was found that after complete precipitation of the silver the solution contained soluble sulphides. This provided a clew, and after appropriate tests the precipitate was proved to be silver sulphide.

Heat Requirements in Chloridizing Volatilization

Fuel Consumption Appears Crucial Point in Commercial Application of Process—Depends Chiefly on Tonnage, Draft, and Radiation

BY RUDOLF GAHL
Metallurgical Engineer, Denver, Col.

VOLATILIZATION of metals is a subject which has recently received much attention, and an article by Harai R. Layng in the Aug. 27 issue of the *Mining and Scientific Press* proved unusually interesting to me. I have tried to estimate the heat requirements of a volatilization kiln, and I quote the following from my records of a test made in Peru.

A fair volatilization was obtained under the conditions specified below with a small test kiln essentially of the same construction as the one used by the U. S. Bureau of Mines.

Rate of feeding ore per day, dry tons	3.02
Fineness of ore	— 14 mesh
Limestone added (—100 mesh), per cent	15
Salt consumption (NaCl, 6 per cent; $CaCl_2$, 1.35 per cent; regeneration, 53.1 per cent), lb. per ton	3.45
Coal used per ton of ore (13,000 B.t.u., pulverized), per cent	14.80
Length of kiln, ft.	24
Inside diameter of kiln, in.	16
Height of lip at discharge end, in.	2
Speed of kiln, r.p.m.	3
Inclination of kiln, in. per ft.	¼
Velocity of gases leaving kiln, ft. per sec., reduced to 0 deg. C.	2
Temperature of gases leaving kiln, deg. C.	340

Most of the salt used was sodium chloride, but a small quantity of calcium chloride was also added, it being assumed that the fume, when melted down with limestone and carbon, regenerates calcium chloride, which would again serve as a volatilization agent.[1] Determinations showed that more than half of the chlorine contained in the volatilization agent is recovered in the fume. This being so, the proportion between calcium and sodium chloride might have been raised. Perhaps there is a slight advantage in using a mixture higher in calcium chloride for the ore in question.

Feeding the salt at the fire end of the kiln seemed preferable to mixing it with the ore. This, I believe, checks the experience of the engineers of the Bureau of Mines, who were feeding the calcium chloride thus when I visited their testing plant.

Finely ground limestone to the amount of 15 per cent of the ore was fed with the ore. The addition of a diluent of some kind seemed to be a necessity in this instance, to raise the sintering temperature.

When conducting some tests on volatilization, with the co-operation of the engineers of the Salt Lake station of the U. S. Bureau of Mines and of the University of Utah, I investigated various addition agents with the view of counteracting the tendency to sinter. Of those easily available, limestone seemed to be the best. I found later that I was not the first to discover this, as the use of limestone for this purpose had been patented in an application antedating my experiments, I believe by G. H. Wigton. Perhaps I should also mention that the Peruvian experiments were made at an altitude of 14,000 ft.

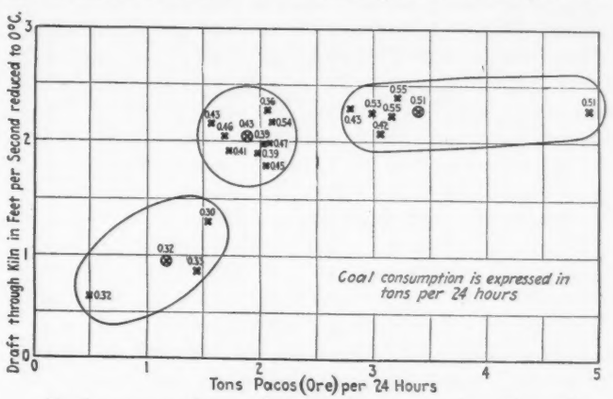
The results emphasized the fact that air is necessary to obtain good volatilization. When the air was reduced to a smaller volume than that mentioned above, the percentage of metal volatilized (silver in this instance) dropped materially. It rose when more air was admitted. The figures as stated seemed to constitute the conditions under which volatilization without excessive coal consumption was best secured.

To obtain as full an insight as possible into coal consumption, which appears the crucial point of the whole process, I have plotted the coal consumed in each test as a function of the tonnage and of the draft. The accompanying cut represents this plot and shows that the coal consumption increases with increasing tonnage and increasing draft. Perhaps the figures are not exact enough to enable one to say with precision how much is due to one factor and how much to the other. However, to shed as much light as possible on the question, an attempt was made to segregate the influence of the different factors mathematically.

Apparently the coal consumption can be represented in first approximation as a linear function of both tonnage and draft and of a constant representing the coal consumed on account of radiation. The coal consumption should therefore be representable by a function of the character:

$$z = a + bx + cy$$

where z signifies the coal consumption, x the tonnage in twenty-four hours, and y the draft in feet per second reduced to 0 deg. C. If three points of the plot are



Coal consumed in volatilization tests, function of tonnage and draft

firmly established, the three constants can be calculated from the position of those three points. With the end in view of locating three points as correctly as possible, the plot was divided into three regions as indicated, and each region was averaged. This resulted in the establishment of the three points that are shown in the plot surrounded by circles.

The determination of the three constants a, b and c, according to ordinary algebraical operation, gives the following results:

$$a = 0.1715 \qquad b = 0.0375 \qquad c = 0.0925$$

The equation quoted above therefore becomes:

$$z = 0.1715 + 0.0375\,x + 0.0925\,y$$

From this formula it is possible to calculate the fuel consumption of the experimental furnace for any tonnage and draft, which, of course, has to be done with a certain amount of precaution, as the experimental

[1]This procedure corresponds to U. S. patent 1,368,885, of Robert H. Bradford.

data from which the formula is derived are not absolutely correct, and as the formula can be expected to cover only the experimental results within a certain range. Nevertheless, I think it is safe to draw the following conclusions:

The coal consumption is caused by three elements, one depending on the tonnage treated, one dependent on the draft, and one independent of both. In other words, if both the tonnage treated and the draft applied were cut down to almost nothing, there would still remain an appreciable coal consumption. This portion of it is apparently due to radiation; it occurs no matter what tonnage of ore is put through the furnace or what draft is used, so long as a certain temperature is maintained.

The amount of radiation indicated by the formula applies, of course, only to the special furnace used in the tests, which had a 4-in. brick lining throughout the whole length and a 2-in. asbestos lining outside for the greater part of the length. It is evident that radiation will be reduced the larger the furnace becomes, because the larger the furnace diameter the smaller the radiating surface in proportion to the cross-section, which is a rough measure of the furnace capacity.

Assuming a furnace so perfect that radiation is almost avoided, the formula derived above would be reduced to:

$$z = 0.0375\ x + 0.0925\ y$$

Then for three tons per twenty-four hours and a gas velocity of 2 ft. per second, reduced to 0 deg. C., the coal consumption would be 0.2975 tons per twenty-four hours, or 9.92 per cent of the tonnage treated.

It may be argued that if this is the coal consumption obtainable with a perfect furnace of those dimensions, it could always be reduced by adding an extra length to it, with the object of utilizing the heat of the gases for preheating the ore. This is undoubtedly true. The same can also be accomplished by providing other means for preheating the ore with the exhaust gases. For instance, the type that is described under the name the Stetefeldt drying furnace in Schnabel's "Handbook of Metallurgy" (Translation by Louis, second edition, p. 815) would seem to be a suitable adjunct to a rotary kiln for this purpose. A similar addition to a volatilization kiln has been suggested by Harai R. Layng (*Eng. and Min. Journ.*, Nov. 12, 1921, p. 769). It would seem to me, however, that although the idea expressed in that article is perfectly sound and in agreement with my own, the form in which it is shown is practicable only in connection with, and perhaps is only meant for, a briquetted feed.

With an entire avoidance of radiation and with perfect utilization of the waste heat of the gases, the coal consumption would be reduced to 3.75 per cent of the feed, assuming the furnace to be fed at the rate of three tons per twenty-four hours, as assumed above.

This, of course, would be an ideal which it might not be possible to approximate under practical conditions; for, if an attempt were made to reduce the coal consumption to such a low point by introducing means for saving the heat contained in the waste gases, it is possible and perhaps probable that the chloride fume would precipitate on the cold ore, which would result in impaired volatilization. It is, therefore, by no means certain that the fuel economy of a volatilization kiln can be carried to the point indicated.

If I understand Mr. Layng's recent article in the *Mining and Scientific Press* correctly, he bases his calculations of the heat requirements of a volatilization kiln on the assumption that 25 per cent excess air is sufficient—which thus broadly stated would seem unsafe to me—and that the gases can be discharged from the kiln at a temperature materially below the condensation point of the fume, so that the latent heat of evaporation of the chlorides can be saved. I am convinced that if condensation of chlorides is permitted in the kiln, the volatilization efficiency will be lowered.

Analogies with other processes hardly prove the point. In the lime-burning operations cited by Mr. Layng, no fume is formed, and, consequently, there is no objection against discharging the gases at a very low temperature. In chloridizing roasting it is a distinct advantage to discharge the gases at a low temperature, as this cuts down volatilization losses; and I wonder if there is not a causal relation between the facts that the Holt-Dern furnace uses a minimum of fuel and (at least according to the claims of its designers) roasts without losses from volatilization.

For these reasons I would not feel convinced by a calculation of such constants as specific heat and latent heat that it is possible to operate a volatilization kiln with good heat economy. I would consider that the Bureau of Mines proceeded correctly in carrying out volatilization in an actual furnace and observing the fuel consumption.

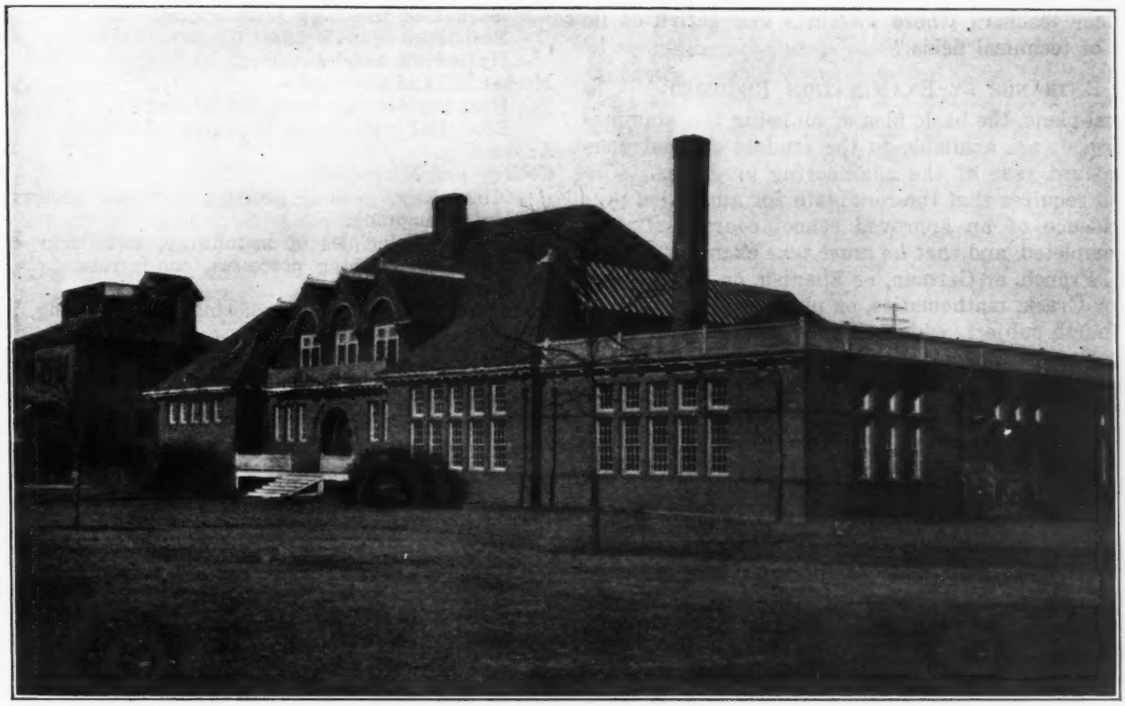
Apparently their experiments, begun I believe by Oliver C. Ralston, have shown that volatilization can be carried out without serious practical difficulty and with a reasonably small percentage of salt. The practical applicability of the process will then largely depend on how far the fuel consumption can be reduced.

In its present form the Bureau of Mines process will hardly compete with other processes except in localities where fuel is unusually cheap. The problem to be investigated next should be to determine to what extent the fuel consumption can be reduced by suitable modifications of the furnace. Possibly Mr. Layng's suggestions to that effect point in the right direction.

Bunker Hill & Sullivan Reports Improved Conditions

The ore blocked out in the Stemwinder, Sullivan, and Bunker Hill mines of the Bunker Hill & Sullivan Mining & Concentrating Co. amounts to 4,227,008 tons. Production during 1921 was high, in consequence of improvement in labor supply; but lowered value of lead resulted in decreased returns. Custom-ore receipts were satisfactory, and are increasing regularly. Operations at the company's smelter and refinery were maintained throughout the year on a satisfactory basis, according to Stanly A. Easton, the general manager.

According to the annual report just issued, the mine at Kellogg produced 426,530 tons of ore, at an average cost of $3.199 per ton, compared with $3.189 in 1920. Exploration work aggregated 3,471 ft., at a cost of $16.81 per foot. The ore was trammed to the mill at a cost of 8.2c. per ton, compared with 9.2c. during 1920. General mill expense was 33c. per ton. The tonnage handled in the plant at Kellogg was 592,346, which included 158,820 tons of Sweeney mill tailing and 11,996 tons of Sierra Nevada ore The concentrate produced amounted to 89,923.20 tons, of the following composition: lead, 41.36 per cent; silver, 13.88 oz. The company shipped 89,746.99 tons of concentrate. Costs and technical data are given in great detail in the highly informative report.



Rotch Hall, containing the Simpkins ore-dressing, assay, and metallurgical laboratories at Harvard University

Mining Instruction at Harvard

Four- and Five-Year Curricula—Close Association of Harvard College and Technical Divisions—Business Administration Subjects and Mining and Metallurgy Brought Together —High Admission Requirements Maintained—Contact With Large University Stimulating

By George J. Young
Western Editor, *Engineering and Mining Journal-Press*

About eleven years ago I visited the mining school at Harvard University, and, in December, 1921, I visited it again. In the decade and more there has been but little change in appearance, in appurtenances, or in other features. Surely, with the many changes taking place in the mining industry during this interval, one would expect to see a commensurate growth in the resources and methods of the school, but such has not apparently been the fact, or at least I was unable to discover it.

Delving into the history of the school, it is of interest to know that undergraduate work in technical subjects was discontinued in 1906, but that it was maintained on a graduate basis until 1914. At that time, aided and abetted by many well-wishers, a flirtation between the Harvard engineering schools and the Massachusetts Institute of Technology resulted in a marriage between the two technical schools. I infer that the marital period was not an altogether happy one. In 1917, the Supreme Judicial Court of Massachusetts decreed that the Harvard McKay fund could not be used in the furtherance of the family life, and a divorce resulted.

The general disturbance of the war period and the shifting of policy from one direction to another, and back again, are without doubt important causes of the present status of the mining school; they furnish an obvious explanation for its failure to maintain a progressive development as noted previously. Before 1914, Harvard undoubtedly had an excellent school, which compared favorably with other mining schools, but at present there is apparent need for an active interest on the part of those in control in modernizing various features of the school.

Harvard established the Harvard Engineering School, of which the mining school is a part, in 1918. This school provided undergraduate and graduate programs. The four-year program leads to a degree of Bachelor of Science, and in the case of mining, an additional year secures the degree of Mining Engineer. Thus it may be inferred that the program on a graduate basis was not a great success. That it was not wholly a failure is shown by the adherence to the idea of a considerable amount of college work in non-technical subjects as a prelude to the technical work. Approximately four-fifths of the four-year engineering program is prescribed and the remainder is available for electives in general subjects to be selected in Harvard College. The student who wishes to spend more time, can give an extra year to general studies before beginning his third year by extending the prescribed studies of the first two years over three years. There is the definite purpose of maintaining close relationship between the student bodies and faculties of the school and college "in order that engineering students may participate fully in the

life of the college, and also have the benefit of instruction under teachers whose interests and activities lie outside of technical fields."

Entrance by Examination Required

Several plans, the basic idea of all being the examination method, are available to the student for entrance into the first year of the engineering programs. The new plan requires that the candidate for admission present evidence of an approved school course satisfactorily completed, and that he must take examinations in English, French, or German, or Spanish, or Latin (two-year), or Greek, mathematics, or physics, or chemistry, and a fourth subject, which may be language, history, mathematics, physics, or chemistry. An attempt to get at the real qualifications of the candidate is made. It is of interest to note that neither Greek nor Latin is definitely required for entrance. In substance, entrance is predicated on attainment of a good high-school course.

In addition to the four-year undergraduate courses in mining and metallurgy, two five-year programs are offered, one in mining and business administration, and one in metallurgy and business administration. Business administration is superimposed on the mining course and begins with the principles of accountancy in the third year. In the fourth year factory management and shop accounting, marketing, and industrial finance, and in the fifth year, business policy, labor problems, and business economics, are given.

The same courses are given in the parallel five-year course in metallurgy and business administration. This grafting of managerial, financial, labor, and economic subjects on the technical course is of considerable interest to mining educators. The attempt to graft cultural subjects upon the technical course is relegated to the background and depends upon the student's volition. These two grafts (I am using the term in its horticultural significance), represent two modern trends, both of which have been furthered by engineers. As there has not been sufficient time for either to take properly, the outcome of this experiment is yet to be seen. I feel sure, however, that the business administration must ultimately be given from the viewpoint of the mining industry and by men thoroughly familiar with the conditions surrounding that industry. It must logically be based upon a thorough course of fundamental economics presented from the industrial viewpoint rather than from the academic. Further, the program logically should be considered for the entire time and the subjects of industrial administration and business practice woven into it consistently rather than appearing as a top graft of dubious virility.

Subjects Covered in Mining Curriculum

The four-year mining course cannot be definitely analyzed, as the courses are inadequately described and time quantities are omitted from the catalog. The subjects given are as follows:

Mathematics—Includes trigonometry, analytic geometry, and calculus.

Chemistry—Inorganic chemistry, theoretical and physical chemistry, qualitative, quantitatve, metallurgical chemistry, and assaying.

Physics—One year.

English—One year or elective if anticipated.

Drawing—Mechanical, freehand, descriptive geometry.

Surveying—Topographical and railroad (eight weeks in summer).

Mining camp—Six weeks or equivalent.

Engineering principles—
- Mechanics, including statics, kinematics, kinetics.
- Resistance of materials.
- Hydraulics and laboratory.

Mechanical and electrical—
- Heat engineering, including laboratory.
- Electrical engineering, including laboratory.

Accounting.

Geology and Mineralogy—
- Mineralogy, general geology, economic geology, geological mapping.

Metallurgy—Principles of metallurgy, metallurgy of iron and steel, leaching processes, non-ferrous metals, ore dressing.

Mining—Prospecting and exploring, metal mining, mining equipment, coal mining.

Fifth year work—Mine surveying, mining projects and design, petrography, economics of mining, mine examinations and reports, problems in the treatment of ores or problems in ore deposits.

The undergraduate course has essentially sound preparation in fundamentals, but has no novel trends, nor are such to be noted in the graduate year. Taking the five years as a whole, there are lacking principles of economics, and sociology and psychology in their relation to industry. The groundwork of engineering principles is given, but further development appears to be relegated to the fifth year and appears in the form of a "project" course, in which the student exploits in an engineering way, on paper, either a real or imaginary mining project. This follows a practice not uncommon in mining schools. Here, as well as at other institutions, the attempt is made to co-ordinate ground-work courses and apply them to a definite problem. Where this is done in a perfunctory way, there is much to be desired, but under painstaking supervision a good deal of benefit accrues to the student. It is an open question whether the same end could not be served better by a systematic set of mining-engineering problems which would tie in all of the various ground-work courses in such a way as to call for concrete application of principles and information, given not only in courses but also available in reference books and periodicals.

Mining and Business Administration

The five-year program in mining and business administration appears to be a concession that something further is needed, in addition to the technical and preparatory courses, to fit a graduate for positions requiring managerial capacity. In the limited time at my disposal I was unable to delve into the substance of the business-administration courses tied on to the technical work, but as I remarked in the beginning, they appear more as appendices than an integral part of the course. Even as such, however, they have value, and the experience of Harvard with them will be of interest to both engineers and others interested in mining education.

The courses devoted to mining and base- and precious-metal metallurgy do not appeal for their novelty in presentation or wealth of accessory facilities. Rather do they appear to need considerable reorganization and modernizing. Apparently, the lecture system prevails, and with it go its inseparable limitations. However, a hard-working student can get, by supplementary work of his own, a fair position in these subjects.

Rotch Laboratory, which includes the ore-dressing, assaying, and chemical laboratories, and the mining class-rooms and library, was planned and equipped a number of years ago, and relatively few changes have taken place since. The ore-dressing equipment is the result of an attempt to put a mill into a laboratory, and

the arrangement does not appeal to me as being either particularly useful or convenient. A great deal could be done in improving and modernizing both the small and large equipment.

Foxcroft House has been turned over to the department of economic geology and has been improved and made suitable for the purpose. This particular unit is well organized and is in keeping with the mineralogical work. Mineralogy, geology, and economic geology have apparently held to a good pace and compare favorably with equivalent work in other institutions.

Only a few of the other laboratories were visited, and the time available permitted only a superficial view. The electrical and mechanical laboratories are interesting. The metallographical laboratory maintains its high standard.

Harvard Conspicuous in Achievement of Its Graduates

Harvard University has been conspicuous, in common with other great American universities, in the achievement of its graduates. It is interesting to inquire into what ideals have been developed that may contribute their share toward producing men of leadership and power. I discussed this subject with Professor H. T. Hughes, dean of the Harvard Engineering School, and the result is given in the following:

The admission requirements of Harvard are the highest. Students are encouraged to participate in the advantages of Harvard College and the life of the institution as a whole. There is close contact of students and faculty as well as intercontact of faculty members. Some of the faculty members are conspicuous leaders in their subjects. The general policy of the engineering school is away from facts and specialization and toward fundamental scientific training. Teaching a man to think and developing ability to solve new problems are the objectives of the instruction. Student activities are subordinated and kept in proper balance.

The foregoing are excellent ideals and in substance prevail to a greater or less extent in all well-organized universities and technical schools. Harvard and other schools may well inspect their curricula and methods of instruction in the light of modern trends and the complex life about us, and determine to what degree general ideals and modern demands upon graduates are being co-ordinated, and the inherent responsibilities of educators fulfilled.

There are not many students in the mining department at Harvard. As far as my information goes, there has been never more than a relatively small number. Whether there will be larger numbers when the engineering school recovers fully from the separation from the Massachusetts Institute of Technology remains to be seen. With greater numbers there will undoubtedly be a larger development of the essentially technical part of the course. The course as a whole, as it now stands, has a certain value to mining students in that it offers good teachers and excellent fundamental work, as well as contact with a great university, in a considerable proportion of the present curriculum. This equips the graduate to develop his own position and strengthen his technical knowledge during the time in which he is getting a foothold in the industry. The course thus affords important advantages to the individual, and the outcome may be quite as satisfactory as would be the case with a more intensive cultivation of technical knowledge in the university.

Mineral Production of Ecuador

The mining industry of Ecuador is limited to the production of gold, petroleum, and salt. The total value of the mineral production is not known, as no official records have been kept, but the production remains approximately the same each year, according to F. W. Goding, of Guayaquil, writing in *Commerce Reports*.

Gold is produced at one mine—the South American Development Co., at Portovelo, in the southern part of Ecuador, near Zaruma. The control of this industry is based on a contract between the Ecuadorian government and the company in charge. The production in 1921 was 22,224 lb. of metallurgic precipitates, valued at $774,975, and 1,313 troy ounces of mill bullion, worth $4,561. The production is disposed of to the United States, the total output being exported. No stocks are kept on hand. A considerable sum has been expended during the last few years to place this industry in a first-class condition, and new veins have been located which are said to be richer than those previously discovered. These mines are rather difficult to reach, all freight and passengers being carried on the backs of mules over the tops of the mountains.

The salt industry of Ecuador is a government monopoly. The deposits are found in the region of Payana, Punta Arenas, Salinas, Charapoto, Crucita, Latucunga, Guaranda, and the Galapagos islands.

Deposits of guayaquillite are found in the Canton of Daule, near the Daule River, and occur over a considerable tract of land. The substance is utilized in the manufacture of explosives. No developments have ever taken place in this district, but apparently the mineral exists here in commercial quantities. It belongs to the fossil resins and has the aspect of an impure wax. Judging from the manner in which the nodules of guayaquillite present themselves disseminated in the alluvial soil along the Daule River, it is not probable that large deposits exist.

Ray Consolidated Mining and Milling Cost Approximately Equal

The thirteenth annual report of the Ray Consolidated Copper Co. for 1921 covers greatly curtailed operations, for the plant was shut down for the last nine months of the year. A total of 351,823 tons was hoisted through No. 2 shaft, an average of 3,627 tons per day. The ore shipped to the mill at Hayden amounted to 349,496 tons, averaging 1.65 per cent copper, and 2,327 tons, averaging 3.10 per cent copper, was sent direct to the smelter for fluxing purposes. Of the total ore, 8 per cent came from development, 2 per cent from active stoping, and 90 per cent from reserve drawing. The mining cost for the year was $1.31 per ton, exclusive of depreciation. Coarse crushing and loading accounted for 4c. of this.

Following shows five years' milling performance:

Year	Tonnage	Feed, Per Cent Copper	Recovery, Per Cent	Pounds of Copper Recovered Per Ton of Ore
1921	406,172	1.646	77.82	25.62
1920	1,706,928	1.720	81.98	28.20
1919	1,621,600	1.814	79.45	28.83
1918	3,411,000	1.613	74.92	24.17
1917	3,560,900	1.635	74.53	24.37

The recovery of copper in the form of sulphide was 89.42 per cent, whereas only 29.66 per cent of the oxide copper was recovered. The cost of milling, exclusive of depreciation, was $1.22 per ton.

Mining Regulations in Mongolia

THE following provisional regulations governing mining enterprises in Mongolia have been sent us by W. F. Collins, now at Peking, China:

1. All exploitation of mines in Mongolia shall be conducted under the following regulations, which are additional to the existing Regulations for Mining Enterprise and administrative orders relating thereto.

2. Mongols desiring to exploit mines in Mongolia coming under Classification 1 of the Regulations for Mining Enterprise shall submit applications in accordance with the requirements of Article 9 of the said regulations as now existing.

3. With reference to minerals coming under Classification 2 of the Regulations for Mining Enterprise: If the land has not been leased by the Mongol owner thereof, he being holder of the surface rights, the situation will be governed in accordance with the provisions of Article 10 of the Regulations for Mining Enterprise and Articles 13 to 15 of the detailed regulations. However, if he shall have leased the land, these prior rights shall belong to the lessee, who will enjoy the same.

4. When additional land is needed by the holders of the mining rights, for any of the purposes set forth in Article 57 of the Regulations for Mining Enterprise, the Mongol owner thereof may not arbitrarily withhold the same in order to obtain an exorbitant compensation. Moreover, holders of mining right are not allowed to engage in other enterprises within the limits of the said land thus acquired, nor within the area of the original mining concession.

5. In accordance with the provisions of Articles 59 to 64 (inclusive), of the Regulations for Mining Enterprise, the (Mongol) owner or other persons concerned, is entitled to compensation (for land taken) under the provisions of the last article (No. 4), but should the Mongol owner have already leased his property to others, then the lessee is entitled to the said compensation.

6. Holders of mining rights shall not prevent the Mongols from having access to the lands of the mining area not yet in actual use, nor to those for which they have received compensation (as provided for heretofore in Article 4), for the purposes of dwelling, pasturing cattle, cultivating, or engaging in other ways the obtaining of a livelihood.

7. In addition to the mining taxes imposed in accordance with the provisions of Article 79 of the Regulations for Mining Enterprise, supplemental taxes shall be paid to the Mongolian authorities as follows:

(a) For concessions on which the mineral being mined comes under Classification 1 of Article 6 of the Regulations for Mining Enterprise, the annual tax shall be ten cents (yuan) per mow (one-sixth acre).

For alluvial sands containing platinum, gold, tin or iron the annual tax shall be ten cents (yuan) per ten chang (117½ ft.) in length of river bed.

For minerals being mined which come under Classification 2 of Article 6, the annual tax shall be five cents (yuan) per mow.

(b) For mining concessions which have not yet been prospected, the annual tax shall be calculated at the uniform rate of two cents (yuan) per mow.

8. In addition to the taxes imposed upon the basis of mineral output or production, in accordance with the provisions of Article 81 of the Regulations for Mining Enterprise, supplementary taxes shall be paid to the Mongolian authorities as follows:

(a) For minerals which come under Classification 1 of Article 6 of the Regulations for Mining Enterprise, a tax of .005 the market price at the place of production.

(b) For minerals which come under Classification 2 of Article 6 of the Regulations for Mining Enterprise, a tax of .0035 the market price at the place of production.

(c) In the future, should the rate of tax to be paid under the existing Regulations for Mining Enterprise be revised, the supplementary area and production taxes imposed under the provisions of Articles 7 and 8 of these regulations shall be paid at the rate of one-third of those imposed by the amended regulations.

After the mining concessionaire has paid the taxes called for by Article 7 and 8 of these regulations, the Mongolian authorities shall not under any pretext extort or levy further commissions, duties, or taxes of any kind.

9. In view of the fact that the additional area and production taxes, as provided for by Articles 7 and 8 of these regulations, have been imposed, should the concessionaire have any difficulties with either Mongol officials or Mongol people, and the latter take advantage of the situation to stir up trouble and hamper the mining operations, it shall be the duty of the responsible authorities to deal with the matter according to law, and in addition, the Mongol head-men will be severally held responsible and required to guarantee the necessary protection and to take immediate measures to do away with the malpractices.

10. It is not permitted to pledge the land surface of mining concessions as security for loans, nor may the land rights be transferred to others.

11. All cases in connection with the exploitation of mines in Mongolia are to be dealt with by the Board of Agriculture and Commerce as well as by the Mining Supervision Office, according to law. The concessionaire, having received his permit (from the Board of Agriculture and Commerce), and the same having been duly registered, he will then apply to the Bureau of Mongolian and Thibetan Affairs for a mining license in the Mongolian language, and the said bureau will issue the necessary instructions to the Mongolian authorities, in order that no misunderstanding may arise.

12. The concessionaire, at the time of taking out the above-mentioned license, in the Mongolian language, must pay to the Bureau of Mongolian and Thibetan Affairs for the same, a fee of 20 per cent of the amount of the registration fee paid to the Board of Agriculture and Commerce.

13. All mines for which permits have already been granted prior to the official promulgation of these regulations shall be subject to and governed by the old procedure.

14. These regulations will take effect from the date upon which they are duly authorized and officially promulgated.

Marketing of Talc*

The Mineral in Ground Form Is Used in a Number of Important Manufactures—No Generally Accepted Specifications Have Been Established—Trade Customs as to Shipment and Settlement—Market Usually Steady

By Raymond B. Ladoo
Mineral Technologist, U. S. Bureau of Mines

TALC[1] is marketed principally in powdered form; it is used in a great variety of industries.[2] The most important uses in approximate order are: in paper, chiefly as a filler; in ready roofing, as a filler and as surfacing material; in paints, as an inert extender; in rubber, as a dusting agent and filler; in textiles, chiefly as a filler; in soap, as a filler; in toilet preparations; in wire-insulating compounds; as a ceramic material; and in dressing leather. Massive talc is sawn into crayons and pencils for metal workers, black-board use, and for tailors (tailor's chalk). When turned or carved into various forms and baked to a hard dense substance it is known as "lava," and is used for gas-burner tips and electrical insulation.

The industries which use talc as a raw material are suggested in the preceding paragraph. Practically all the ground talc sold is ground by the producers of crude talc, and little is sold for later grinding by jobbers.

Largest Markets in Northeastern States

The largest markets for talc are the great industrial districts east of the Mississippi and north of Virginia and Kentucky. No system of centralized marketing points or "basing points" exists in the talc industry, and practically all talc is sold f.o.b. cars at mill. For Vermont talc the principal points are Johnson, Waterbury, East Granville, Rochester, and Chester, Vermont; for New York talc the principal points are Gouverneur and Natural Bridge; for California, Los Angeles and Keeler. Some large talc companies are not much interested in job-lot business, but prefer to sell in car lots to jobbers and let them handle the smaller orders. Thus the marketing points for small lots may be New York, Chicago, Philadelphia or other cities where jobbers maintain warehouses.

Exports Negligible

The annual consumption of talc in the United State for the last ten years is shown in the accompanying chart. As exports are negligible, total domestic consumption has been assumed as domestic production plus imports. Seasonal fluctuation in demand seems to be small, though possibly a stronger demand is usually shown in spring and summer, particularly for the grades of talc which enter into building supplies such as paint and ready roofing.

Specifications Not Generally Standardized

No generally accepted standard specifications and tests for talc now exist, although some individual consumers have their own standards. Most talc is purchased either on the basis of a comparison with material previously used and found satisfactory, or upon the basis of actual plant tests. In general, chemical analyses are of little value and are not often made, for the value of a talc usually depends upon physical properties such as color, fine grain-size, "slip," and "retention." However, some consumers, for example some manufacturers of paper and of toilet powders, demand a low lime content. To other consumers in the same industries lime does not seem objectionable. A high content of iron oxide is often detrimental, as it usually indicates poor color. In some industries a high silica content is objectionable, for it indicates free silica or grit.

Apparently, specific gravity of the ground talc may be important for some industries—paint, for example. New York fibrous talc may vary from thirty-one up to forty-six pounds per cubic foot.

A high-grade talc, in general, should be of a pure white color, low in lime and iron, free from grit and specks or impurities, and finely ground (200 mesh or finer). A good "slip" (greasy feel) may or may not be desired. This grade of talc is used mainly by the toilet-powder trade.

Industrial talc usually is not as pure white in color, excepting New York fibrous talc and some Canadian talcs, as that used for the other purpose noted. It often contains lime and sometimes free silica; often it is not as finely ground.

Various Types Named for the District

Talcs from various districts vary greatly in appearance and physical properties and are known to the trade by the name of the district from which they come. The principal types sold in the United States are Vermont talc (foliated, granular, and "grit"[3] talc); New York fibrous talc, also known as asbestine, (from the Gouverneur district, St. Lawrence County); New York granular talc (from the Natural Bridge district); North Carolina pyrophyllite (from Glendon and Hemp, N. C.); North Carolina white talc; California toilet-grade talc; Canadian talc (toilet and industrial grades); and Italian and French talcs (toilet grades).

The fineness of grinding varies widely and depends upon the use for which the talc is intended and upon the consumer's ideas of his needs. In general, industrial grades of talc are standardized according to the proportion through a 200-mesh sieve, various specifications requiring from 95 to 99.8 per cent through the screen. Roofing-grade talc, if used as a dusting agent, may have a maximum grain size varying from 100 to 140 mesh or even finer. For prepared roofing granules various grades, such as through 20 mesh on 40 mesh, through 40 on 60, through 40 on 100, through 30 on 80, and so on, are made.

Talc pencils and steel workers' crayons are sawn from massive talc. The 5-in. length has been the stand-

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[1]With talc is also included pyrophyllite, which closely resembles talc in nearly all its properties and is mined, ground, and sold as talc.

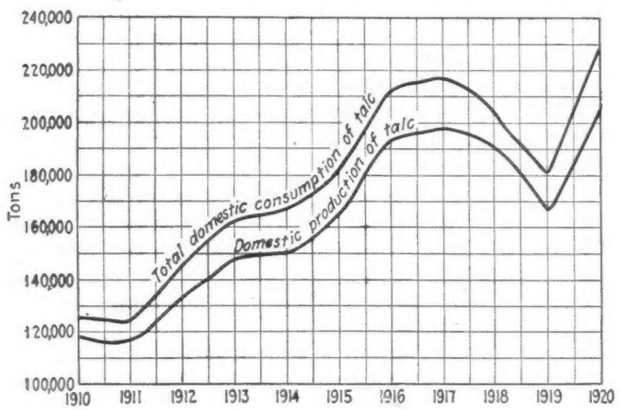
[2]An extensive list of uses is given by Ladoo, R. B., "The Uses of Talc and Soapstone," *Chemical & Metallurgical Engineering*, Aug. 11, 1920, pp. 235-236.

[3]"Grit" talc is a local name for an intermixture of talc and dolomite.

ard, but lengths of 3½ and 4 in. have been made, and the 4-in. length may become standard, due to its greater stoutness. Some of the most common sizes made are, in inches, ¼ x ¼, 1¼ x $\frac{7}{16}$, ½ x ¼, ½ x $\frac{7}{16}$, and ½ x ½. These are packed in wooden boxes containing one-half to one gross each. Fairly hard, tough crayons are preferred, as they are stronger and do not wear readily.

Material Should Be Kept Dry

As the costs of fine grinding by dry methods increase greatly for damp materials, an effort is made to keep the talc as dry as possible. Thus the moisture in the finished product is usually low. The price of the finished talc is influenced little if at all by small variations in quality. If the talc is satisfactory it is accepted at the contract price; if it is unsatisfactory it is rejected and will not be taken at any price. Large consumers of talc usually buy on a yearly contract basis, and all shipments are in carload lots. Small purchases from jobbers may be in any quantity, from a few



Curves showing production and consumption of talc in the United States

pounds up to a minimum carload, but usually are in multiples of 50-, 100-, or 200-lb. bags.

As noted, talc is either accepted by consumers as satisfactory or entirely rejected. Therefore no system of premiums or penalties prevails. There is no standard system of sampling talc by consumers; in fact, some consumers rarely test their talc, except in purchasing from a new source, unless something goes wrong in their plant which might be attributable to the talc. In any circumstances samples are usually taken at random.

Sundry Specific Tests May Be Made

There are no fixed standards of grade, quality, or type of talc and no uniform, standard methods of testing used either by producers or consumers. The only tests approaching a standard are screen tests, but no standard screen scale has been adopted and some screen tests are made dry and others are made wet. Thus even guaranteed screen tests have little meaning.

Grit is determined qualitatively by "gritting" between the teeth, by drawing a spatula over a small quantity of talc on a piece of crisp paper, by rubbing between the thumb or finger nails, or by noting the residue after elutriating with water. *Shape and nature of grains* is determined microscopically. *Suspension* tests are sometimes made by shaking up a definite quantity of talc in a definite quantity of water (or oil) and noting the time of settling, or the amount of settling in a given time. *Retention* tests for the paper industry must be made by actually making samples of paper with definite quantities of talc. It should be noted that suspension and other tests used by paper-mill chemists to determine the value of clay as a paper filler are wholly inadequate and misleading when applied to talc. Talcs which show poor suspension often have an unusually high retention value. *Color* tests are made by comparison with an acceptable "standard," either in a dry condition on the hand or on white or blue paper, or, wetted with oil or turpentine, on paper or glass. Other tests may be used by individual companies to suit their own needs.

Few tolerances in weighing or analyses are recognized in the trade, except that the weights of bag and sack containers are usually included in net weights. Some consumers have their own tolerances for screen analyses, but these are variable.

Transportation, Storage, and Shipment

Talc is packed in 50-lb. paper, 100-lb. cloth (often double thickness) and 100- and 200-lb. burlap bags. The 50-lb. paper sacks and 200-lb. burlap bags are probably the most common containers. For the paper trade, paper sacks are often preferred, so that the whole package, without emptying, may be thrown into the pulp beater. Some of the lower grades of talc, roofing grade for example, are also sometimes shipped in bulk in tight box cars.

Storage at the grinding mill is usually in bags stacked high in dry storage sheds, though a few producers store in bulk and bag only on order just before shipment. This reduces the loss by breakage of paper sacks and decreases handling charges. The principal objection to bulk storage is that some talcs have a tendency to pack in bins, and removal may be difficult.

Shipment is made in tight box cars, which are thoroughly swept or even washed, and are often lined with building paper to prevent contamination. Cargo is packed and braced, and doors are boarded so that serious movement in transit is impossible. The minimum carload varies from 36,000 lb. to 60,000 lb., depending upon railroad and length of haul; maximum carload is the carrying capacity of the car, often thirty tons. It is not customary to insure talc shipments.

Settlement Based on Bag Count and Railroad Weight

The value of a talc shipment is based upon a fixed price per net ton. Weights apparently are settled on the basis of bag count checked by railroad weights. In some instances prices include bags; in others an extra charge is made at the rate of $1 per ton for paper sacks or $3 per ton for returnable burlap bags. Terms of settlement vary from net cash, thirty to sixty days, to 1 to 2 per cent discount for payment in ten to thirty days.

To market successfully, a producer should be thoroughly familiar with the varied needs of his different types of customers. He should be sufficiently acquainted with the methods of manufacture used by his customers, so that he may recommend the most suitable grade of talc and demonstrate its value. This is important, for there are so many varieties, types, and degrees of fineness of talc that one grade may be wholly unsuited for a given purpose, though another may give excellent results.

There are no important trade groups which control marketing conditions and prices. The bulk of the production is sold by producer direct to consumer in carload lots. The broker or jobber usually sells in small lots. However, the middleman, even in such small sales, has an important influence on the talc industry, an influence not often recognized. Possible customers for talc in new lines of industry often buy small trial lots of talc from jobbers who usually have no technical knowledge or interest in the product. If the single sample tried is not suitable, talc in general may be condemned and a wall of prejudice built up which is difficult to break down. This has retarded the development of new uses in several instances.

Range of Prices Is Wide

The price of talc varies greatly, depending upon its quality, degree of fineness, and intended use. As this is written (March, 1922,) the following ranges of price prevail per short ton, f.o.b. cars grinding mill:

Vermont, 20-50 mesh (roofing grade), bulk (bags extra)	$7.50-$8.50
Vermont, 150-200 mesh, bulk (bags extra),	8.00-16.00
New York, fibrous talc, 150-300 mesh in bags	14.75-18.00
New York, granular talc, 150-200 mesh, in bags	12.00-13.00
California, toilet powder grade, in bags	16.00-20.00
Talc crayons, produced mainly at Chatsworth, Ga. Glendon and Hemp, N. C., Waterbury, Vt., per gross	1.00- 2.00

The only conditions which influence price are those of grade and degree of fineness, except for competitive conditions with other talc producers and with producers of competitive materials. Thus, as a paper filler, talc must compete both on a quality and on a price basis not only with other talcs but also with English China clay and with white filler clays from the South. In fact, the chief competitor of Vermont talc is not New York talc but clay, particularly English clay.

The marketing unit for ground talc is the short ton, and for talc crayons, the gross. The average weight of the most common size of talc crayons, that is ½ x ⅞ x 5 in., is about 7½ lb. per gross. Fluctuations in prices are small and changes are slow, perhaps due to the sale of large quantities on a yearly contract basis.

As noted before, prices of talc of a definite grade from a definite mine do not change with small changes in quality. Prices of 150- to 200-mesh talc of industrial grade at present range from $9 to $18 per ton. Toilet-grade talc from California sells in Eastern markets at $35 to $40 per ton in competition with imported high-grade French talc at $40 to $45 per ton f.o.b. New York City, and with Italian talc at $44 to $55. These prices represent the range due to differences in quality for ground talc of approximately the same fineness. Prices bear no close relation to quantities sold nor to the time of year, except, of course, that less-than-carload lots bring a higher price, and some price concessions may be made to large consumers.

The following prices, from the U. S. Geological Survey, represent the average selling price of all grades of ground talc per short ton for the years 1913 to 1920.

Year	1913	1914	1915	1916	1917	1918	1919	1920
Price ..	$8.42	$8.54	$8.37	$8.57	$9.11	$10.55	$10.55	$12.00

The prices for the various grades for many years have borne about the same relation to one another as that indicated previously.

Imports Are an Important Factor

Imports of talc in the past have had little effect on domestic prices or production. In recent years, however, since toilet-grade talc has been developed in California, imports of high-grade Italian and French talc have offered serious competition to the domestic product. Talc mining in California is expensive, and freight rates to the principal markets in the East are so high that successful competition, without an adequate protective tariff, with the low-priced but high-grade European talcs, is difficult.

Talc from the Madoc, Ontario, district, in Canada, is of from medium to high grade, and sells for a price intermediate between that of domestic industrial grade and that of imported toilet grade. This talc competes in part for the toilet trade, and in part for the higher-class industrial trade. Competition from this source has been felt, so far, by but few domestic companies; but with a low tariff and increased Canadian production the competition in some lines may be important. The record imports of all talc (in 1920) amounted to about 10 per cent of domestic consumption by tonnage and about 19 per cent by value.

The competition afforded by imported English China clay, especially in the paper trade, is severe and helps to keep down the price of paper-grade talc to a point where there is little profit for some producers.

Domestic and Foreign Talcs Compared

As previously noted, imported talcs differ considerably from most domestic talcs in type and quality, and are largely non-competing except for the toilet-powder grades. The toilet-powder trade has a strong prejudice in favor of European talcs, particularly Italian, which is noted for its absolutely white color, good "slip," fine grain size, and freedom from grit and other impurities. The best grades of California talc seem to equal the Italian talcs in every way. Some consumers recognize this equality, though others insist that there are no domestic talcs equal to the Italian. As the value of the talc itself is such a small part of the sale price of a package of talcum powder, manufacturers of toilet goods can afford to purchase Italian talc, even if its superiority over the best California talc is not established.

"Nickel Cans" Instead of "Tin Cans"?

Experiments with a view to making nickel-coated steel sheets as a substitute for tin plate have been in progress for about twelve months in England, according to *The Ironmonger*. It is stated that among those interested in the process is Henry Mond. Despite the optimistic reports which have appeared in the daily press, the experiment so far does not seem to have been commercially successful, although some samples have been produced. The aim of the process is to produce a steel sheet coated with nickel, just as sheets coated with tin are now manufactured. Practical tin-plate makers are skeptical as to the possibilities of obtaining a sufficiently ductile product, and this want of ductility appears to be one of the principal difficulties to be overcome.

Some years ago one of the important Welsh steel and tin-plate concerns laid down a plant for the production of aluminum-coated steel sheets, which, it was suggested, would supplant tin plate in the manufacture of food containers and domestic ware. The product, however, did not prove popular, and although efforts were made to interest the biscuit manufacturers and other large users of the material, the process was not a commercial success, and in the end the plant was scrapped. Any substitute for tin plate will have to overcome a considerable amount of prejudice, because, despite its limitations, tin plate is regarded by food packers and others as the most satisfactory material obtainable for their purpose.

USEFUL OPERATING IDEAS

Hanging Scaffold for Taking Down Loose Back in High Ground

Ingenious Method Employed to Reach Otherwise Inaccessible Points in Lofty Untimbered Stopes

BY IRWIN H. CORNELL

AT THE Bonne Terre division of the St. Joseph Lead Co. properties open stopes of great height are not uncommon. There are a number of these stopes ranging from 70 ft. to 160 ft. high, so the ordinary practice of the district of building towers to the back to take down any loose rock is not practicable. E. W. Campbell, mine captain, has devised an ingenious method of hanging scaffold to the back by means of hooks and eye-bolts which is simple in construction and unusually flexible in its application.

Upper portion of stope 157 ft. high in mine of St. Joseph Lead Co., Bonne Terre, Mo., showing scaffold in use.

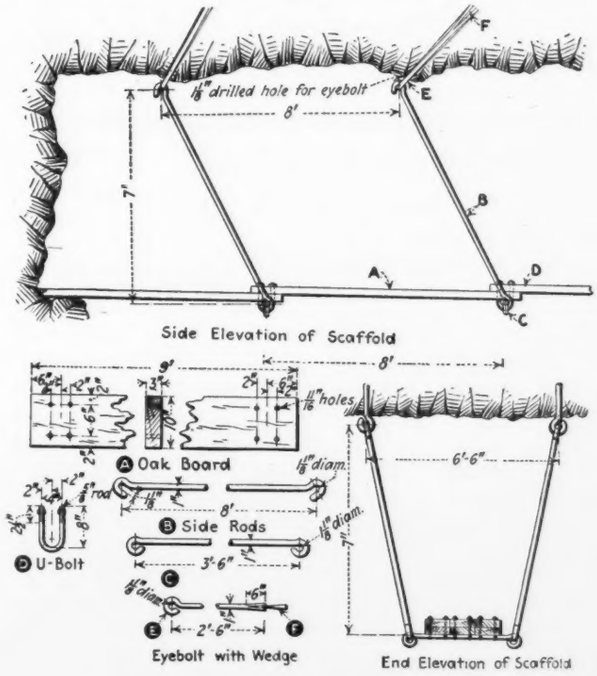
The accompanying picture shows the upper part of a stope 157 ft. high in which the back became loose. It was necessary not only to take down the loose rock but to provide a permanent means of testing this ground for protection of the mechanical-shovel crew working on the ground immediately under this area. A 3-ft. roadway around the breast of this stope, 7 ft. from the back, did not furnish means of reaching the loose ground in the center which had to be taken down.

With the machine set up on this roadway, two 3-ft. holes were drilled at an angle of approximately 45 deg. with the horizontal plane of the back in the portion shown in the side and end views of the accompanying sketch. Into these holes, eye-bolts (*E*) with wedges (*F*) were driven until secure. From these eye-bolts, side rods (*B*) were hung, which, when hanging vertically, were within easy reach of the miner standing on the roadway. After cross rods (*C*) connecting the side rods were placed, oak boards (*A*) were fastened to the cross rods by means of U-bolts (*D*) and the entire section was pushed forward until side rods were in the position shown in the side view of the sketch. The oak boards were then pinned securely to the roadway and the first section was completed. The next set of eye-bolt holes was drilled from the end of the completed section and the second section extended in the same way.

The scaffold proved to be steady enough to permit setting up a column at the end of each section, and in this way flat holes were drilled to take down the loose ground ahead. By changing the position of the eye-bolt holes and the holes in the boards, fourteen sections of the scaffold were extended in an arc of a circle to permit trimming the brow tied between pillars. By additional tie rods, the scaffold was braced to prevent swinging sideways, and seven sections were extended at right angles to the others as shown.

Three men, accustomed to this work, can easily put up three or four sections in one eight-hour shift, and the same crew can take down from six to eight sections with no loss of material except the eye-bolts fastened in the back.

Details and dimensions of the scaffold described are given in the following drawing.



Details of hanging scaffold

A Handy Gear Reduction

By Charles Labbe

When a slow revolving motion is needed, it is at times difficult to find anything suitable. A handy gear reduction can be made out of a tool grinder. A pulley disk of any size can be clamped in place of the emery wheel, and another disk, a pulley, or agitator arms can be attached to the shaft in place of the crank. By using different sizes of pulleys or disks made of wood or metal, nearly any speed ratio can be obtained. The gear reduction is usually 30 to 1.

Wanted— Useful Operating Ideas

WHAT ingenious devices or methods are you using in your plant? Something out of the ordinary is to be seen in many mines and mills. Standard practice does not always give the solution to difficulties that arise in operation. Then again, necessity may be the mother of invention. Often these products of ingenuity are little known outside a limited area. These pages are intended to serve as an exchange of such ideas. Articles and sketches describing them will be welcomed.

—Editor.

Making a Steep Flight of Steps Safe

By Henry M. Payne

A unique method of making a steep flight of steps safe and easy to ascend or descend when both hands are occupied is shown in the accompanying photograph. The steps in each set have a 9-in. tread and 18-in. risers, so that, as staggered, the effect is that of a 9-in. tread and 9-in. risers, or the equivalent of 45 deg. The construction is so simple and the results are so practical that it seems strange that the idea has not been worked out before (or has it?). The photograph was taken at the smelter of the Bunker Hill & Sullivan Mining & Concentrating Co., at Kellogg, Idaho, in the Coeur d'Alene district.

Steep flight of steps of novel construction

Filing Tracings

By Roy H. Poston

New tracings filed in flat drawers and cabinets usually curl up, especially if the drawing is on the smooth side, which is usually rolled on the inside of the roll by the manufacturer. To obviate this, each new tracing should be filed on the bottom of the pile. It should project sufficiently toward the front of the drawer and beyond the drawings above to permit the file number written on its margin to be seen. If kept in this manner, tracings and drawings will be found readily when they are wanted.

THE PETROLEUM INDUSTRY

Favorable Structures in Iniskin Bay Area of Alaska*

The Iniskin Bay oil field, which is on the small peninsula between Iniskin and Chinitna bays, on the west side of Cook Inlet, in Alaska, has been known as a possible source of petroleum ever since petroleum seeps were discovered there by the Russians in 1853. From 1902 to 1906 Oil Bay, which is on the south side of the peninsula, and Dry Bay, which is about five miles northeast of Oil Bay, were scenes of active drilling, but the work done did not show conclusively the value of the field. No drilling was done after 1906, although much of the ground abandoned then has been restaked since the oil-land leasing law was passed, in 1920. In 1921, detailed topographic and geologic surveys of the district were made by F. H. Moffit, of the U. S. Geological Survey.

The peninsula has a total area of about 150 square miles, but at least twenty square miles of it is occupied by igneous rocks, which cannot possibly contain petroleum, so that the surveys made in 1921 were confined to the area occupied by sedimentary rocks. Practically all the peninsula except its extreme west side is occupied by sedimentary beds of Middle and Upper Jurassic age. The lowest formation (Middle Jurassic) is the Tuxedni sandstone, which has a thickness of possibly 8,000 ft. This formation may be divided into a lower part, whose beds are prevailingly sandstone and sandy shale, but include also minor amounts of conglomerate, arkose, and a little limestone; and an upper part, whose beds are chiefly sandy shale, but include thin beds of sandstone and a few thin beds of conglomerate.

The Tuxedni sandstone occupies the central and western parts of the peninsula and is separated from the volcanic rocks of the mainland by a great fault which runs parallel to the axis of Cook Inlet. The Tuxedni sandstone is overlain by the Chinitna shale (Upper Jurassic). It is a fairly homogeneous formation, about 2,300 ft. thick, consisting of gray and black shale, containing throughout many beds of concretions and, in its upper 500 ft., many sandy, calcareous beds that become yellow on weathering. Above this shale comes the Naknek formation, beneath which locally there is a massive coarse conglomerate called the Chisik conglomerate, which consists chiefly of igneous boulders and cobbles and which reaches a thickness of 290 ft. on the shore of Iniskin Bay.

The Naknek formation is at least 4,500 ft. thick. Its lowest beds throughout most of the area are fine conglomerate and arkosic sandstone (probably equivalent in time to the Chisik conglomerate), which are overlain by sandy shales and thin beds of sandstone. This lower part of the Naknek formation is about 1,500 ft. thick, and is overlain in turn by massive white or light-colored beds of sandstone, which form conspicuous cliffs along the crest of the mountains near the coast of Cook Inlet and have protected the underlying softer shale and sandstone from erosion.

The sedimentary beds are folded in such a way as to form a broad major anticline that extends north-northeast through the valleys of Bowser and Fitz creeks from Oil Bay to Chinitna Bay. All the sedimentary beds east and south of the anticline as far as the shore of Cook Inlet dip toward the curving coast line. West of the anticline is a syncline, which is followed farther west, in the valley of Portage Creek, by a closely compressed anticline. Part of this anticline, however, is cut off by the great fault. Because of this fault and of the closeness of folding and the generally disturbed condition of the beds, the westernmost anticline offers little encouragement to prospectors for oil.

All the known oil seeps of the Iniskin Bay field are in beds of the Tuxedni sandstone, although the gas spring at Dry Bay is in a higher formation. The principal oil seeps are either near the head of Oil Bay or on Iniskin Bay, and possibly owe their presence here to the faulting and jointing that have affected the Tuxedni sandstone in this vicinity. The main anticline of the valleys of Bowser Creek and Fitz Creek flattens out near Oil Bay and pitches beneath the Chinitna shale between Iniskin and Oil bays. An east-west fault cuts out the upper part of the Tuxedni sandstone in this locality and brings the lower part into contact with the Chinitna shale. The oil from the seeps at Oil Bay and the drill holes therefore appears to come from a horizon not higher than the middle beds of the Tuxedni sandstone, but there is no evidence to determine where it originates.

The oil from the seeps is dark green when it first comes up, but turns dark brown on exposure to the air. It has a paraffin base, and would be a refining oil. Four wells were drilled at Oil Bay between 1902 and 1906, two of which yielded oil and gas in amounts that are now difficult to determine. The first and deepest well is said to have been sunk to a depth of more than 1,000 ft., and was abandoned because of salt water. The third well was sunk to 900 ft. Both wells are reported to have obtained oil from beds about 700 ft. below the surface. The wells are near the axis of the anticline that extends through Bowser and Fitz Creek valleys, but are in an area where the fold is much flattened and is beginning to lose its identity as an anticline. The wells are in the disturbed area near the intersection of the east-west fault with the jointing and fault planes parallel to the shores of Oil Bay, which, as already pointed out, have possibly given rise to the oil seeps near by. Two wells were started near Dry Bay at about the same time as the wells at Oil Bay, but both were abandoned because of loss of tools or accident to the machinery. Although oil lands have again been staked in the Oil Bay district, no work has been done there recently, and, so far as is known, no drilling is being considered in the near future.

Further prospecting in the Iniskin Bay oil field might well be extended so as to test the main axial anticline of

*Abstracted from Report, U. S. Geological Survey.

the peninsula, instead of being restricted to the vicinity of the known oil seeps. It should be kept in mind, however, that the valley of Bowser Creek, and the corresponding valley north of it, may be eroded below the horizon at which the oil occurs, and that in consequence the boundary between the Tuxedni sandstone and the Chinitna shale may prove to be a more favorable location for drilling. The area of anticlinal structure between the right arm of Iniskin Bay and Chinitna Bay is less promising for oil, as the gathering ground is smaller, and the beds have been shattered and otherwise greatly disturbed by faulting.

In summarizing, it may be said that the Iniskin Bay region includes a number of long, narrow anticlines, which are joined on the seaward side by a great monocline. This monocline should have afforded a considerable underground drainage area for oil, and may contain valuable pools.

Oil in Peru and the New Petroleum Law

Special Correspondence

In no Peruvian product, except silver and copper, is the ascending scale of products, for the capital invested, more marked than in that of petroleum. Peru's oil fields, it is claimed, hold promise of a great national revenue. In 1903 her total oil yield was 11,639 tons; 235,133 tons was produced in 1919; and in 1921 these figures were more than doubled, with 500,000 tons. The export duties on oil and oil byproducts in 1919 brought a large revenue to the state, the basis of duty being approximately $4 a barrel.

Peruvian oil was well known under the ancient Inca regime and was used for painting pottery and other industrial purposes. The Spaniards also used it for caulking. In more modern days the geologist revealed to the world the great deposits of the Montana, of the long 1,500-mile stretch of coast from Port Tumbes to Ilo, of the hills at 8,000 to 15,000 ft. above sea level, and of Abancay and Ayacucha. In the center of Peru oil was found in the Nazca region, and also in the provinces of Yauli, Jauji and Huancavelica, although there its extent and value need a more precise investigation. In southern Peru at Canas, Lampa, Azangaro, and especially at Huancane, near the shores of the mountain lake, Titicaca, commercially satisfactory oil has been found.

Following the geologist, in 1867, came the earliest modern exploiters of Peruvian oil, the Americans. Later still, in 1888, came the London Pacific Petroleum Co., which completed its No. 8 well in 1899, and whose eventual output rose from 40,000 tons in 1904 to 350,000 tons in 1920. The year 1914 recorded the coming into the field of the International Petroleum, Ltd., controlled by the Imperial Oil, Ltd., itself mainly owned by the Standard Oil Co. of New Jersey. Another great company is the Lobitos Oilfields, Ltd., whose production is taken, under contract, by the International Petroleum, Ltd. These various companies have drilled 1,406 wells, of which 849 are at present producing.

The new petroleum law is framed on the same lines as the Mining Code. The duties imposed are not to be altered for twenty years and the act is designed to develop greatly the Peruvian oil industry. By its terms all laws and regulations in conflict are repealed, although existing concessions may be made to conform to it if desired. Under it all petroleum and hydrocarbons are national property. The superficial extension of the concessions granted under this law will be divided into areas of 40,000 sq.m., called claims. No exploration block granted shall exceed 15,000 claims on the coast, 20,000 on the Sierra, and 30,000 in the Montana. The term of an exploration concession may be four years, with power to extend for another two years. An annual exploration tax shall be paid on each claim of one sol on the coast, 40 centavos in the Sierra, and 20 in the Montana, payable semi annually.

Exploitation privileges shall be granted for an indefinite period. Two classes of contributions are required from the concessionnaire of an exploitation zone, one on the area of the concession and the other on the production of the well or wells. The contribution on the former is approximately $5 annually per claim, payable semiannually in advance; on the latter according to a prescribed scale, which gives 50 centavos on a production of ten or more tons per claim. In concessions in the Sierra or Montana, the scale is reduced 50 per cent.

No foreign government, nor any company in which a foreign government is interested, may secure petroleum concessions in Peru. All companies shall be constituted in conformity with the Commercial Code, and be considered as national companies with domicile in the republic.

Government in April Nets $1,000,000 From Oil Leases

Royalties accruing to the United States Government in the month of April from the production of oil and gas on leased public lands in the states of Wyoming and California amounted to $1,009,007.86, according to reports submitted by the Bureau of Mines to the General Land Office. Of this amount, $784,600 is credited to Wyoming and $224,400 to California. The total net royalties accruing to the Federal Government to April 30, as the result of oil and gas production on public lands under the terms of the general leasing act, approved Feb. 25, 1920, amount to $4,650,286.81. A total of 7,328 permits for prospecting for petroleum and natural gas on public lands had been issued up to the end of April.

Under the terms of the general leasing law, the technical supervision of oil and gas producing operations on leased public lands is intrusted to the Bureau of Mines. Offices for the conduct of this supervisory work are at Denver, Col.; Casper and Salt Creek, Wyo.; Bakersfield, Cal.; Winnett, Mont.; and Shreveport, La., general headquarters being in Denver.

Prospecting for Oil in Australia

Special Correspondence

The finding of pieces of pitch in the Kimberley field, North West Australia, has resulted in the formation of a number of companies for oil exploration, and already a number of geologists and prospectors has been dispatched to the field. Three members of state geological departments have been granted leave of absence to report for various leaseholders, namely T. Blatchford, of West Australia; L. J. Jones, of New South Wales, and D. J. Mahony, of Victoria. Huge areas are already held by some of the prospecting companies, and as the country is only sparsely settled and without means of transport, many delays and difficulties will be experienced before definite results can be expected.

New Books

Science for the General Reader

A committee of the Washington Academy of Sciences recently published a list of one hundred popular books in sciences. The selection is a tentative one, and criticism is invited. The first test for the kind of a book that is considered desirable for the list is: Would the average reader who uses a public library, after beginning to read the book in question, read it through to the end and come back to the librarian for another on the same subject? The list follows, some of the titles being somewhat abridged, and the names of publishers and other details being omitted: "The Origins of Invention," Mason; "Woman's Share in Primitive Culture," Mason; "Men of the Old Stone Age," Osborn; "The Study of Men," Haddon; "Savage Childhood," Kidd; "The Hopi Indians," Hough; "Newer Knowledge of Nutrition," McCollum; "Food Products," Sherman; "Origin of Species," Darwin; "Inbreeding and Outbreeding," East; "Heredity and Eugenics," Castle et al.; "Theory of Evolution," Morgan; "Heredity and Environment," Conklin; "Hereditary Genius," Galton; "Applied Eugenics," Popenoe; "Wonder of Life," Thomson; "Problems of Evolution, Headley; "Hybridization," Lotsy; "Life and Her Children," Buckley; "Winners in Life's Race," Buckley; "Living Plant," Ganong; "Experiments with Plants," Osterhout; "Physiology of Plants," Sorauer; "Flowers, Fruits, and Leaves," Lubbock; "Geography of Plants," Hardy; "Insectivorous Plants," Darwin; "Sand Dunes and Salt Marshes," Townsend; "American Animals," Stone; "African Game Trails," Roosevelt; "Jungle Peace," Beebe; "Camps of an Ornithologist," Chapman; "Wild Birds," Herrick; "Insect World," Fabre: "Wasps," Peckham; "Life of the Bee," Maeterlinck; "Vegetable Mould," Darwin; "Gleanings from Nature," Blatchley; "Upland and Meadow," Abbott; "Seashore Life," Mayer; "Animals of the Past," Lucas; "Extinct Monsters," Hutchinson; "Geology," Dwerryhouse; "The Story of the Earth," Seely; "The Changeful Earth," Cole; "Evolution of the Earth," Lull; "Time and Tide," Ball; "Political and Commercial Geology," Spurr; "Geographic Influences in History," Brigham; "Work of Rains and Rivers," Bonney; "Waves of the Sea," Cornish; "Volcanoes," Bonney; "Volcanoes of North America," Russell; "About the Weather," Harrington; "Climate and Weather," Dickson; "Weather Science," Lempfert; "Climate," Ward; "Realm of the Air," Talman; "The Ocean," Murray; "Rocks and Their Origins," Cole; "Rocks and Minerals," Bennett; "Guide to Minerals," Gratacap; "The Sun," Abbot; "Story of the Heavens," Ball; "Astronomy," Dyson; "Stellar Evolution," Hale; "Splendors of the Sky," Lewis; "Beginner's Star Book," McKready; "Voyage Through Space," Turner; "Lectures in Astronomy," Stahl; "Creative Chemistry," Slosson; "Everyman's Chemistry," Hendrick; "Chemistry of Commerce," Duncan; "Modern Chemistry," Martin; "Matter and Energy," Soddy; "Fragments of Science," Tyndall; "Relativity," Einstein; "Physical Science," Whetham; "Constitution of Matter," Ames; "Waves and Ripples," Fleming; "Spinning Tops," Perry; "Musical Sounds," Miller; "World of Sound," Bragg; "Light Waves," Michelson; "Colour Measurement," Abney; "Soap Bubbles," Boys; "Radium," Soddy; "Number Concept," Conant; "Mathematics," Whitehead; "Philosophy of Mathematics," Shaw; "Study of Mathematics," De Morgan; "History of Science," Libby; "History of Science," Sedgwick; "Warfare of Science and Theology," White; "Number Stories," Smith; "Astronomy," Berry; "Chemistry," Thorpe; "Founders of Geology," Geikie; "History of American Geology," Merrill; and "Biology and Its Makers," Locy. We are ashamed to say that we have read so few of these books that we shall not attempt to criticize or suggest substitutions. Copies of the reprinted bulletin containing comments on each book may be obtained from Robert B. Sosman, editor of the *Journal of the Washington Academy of Sciences*, Washington, D. C.

The Sordid Side of a Mining Camp

Sketches of Butte. By George Mesley Davis. The Cornhill Company, Boston. 1921. $1.75.

This is an odd little book; likewise it is interesting. At least half of the incidents related lack even the most remote connection with Butte. The author apparently has them in his system and uses the book as a vehicle for getting them into print. He is by no means a scholarly writer but he has some entertaining ideas on the philosophy of life, and his style is agreeable enough. He fancies his own "poetry," but is considerate in inflicting only small doses.

In his effort to be impressive he overdoes things. For instance, he talks of "a city of upward of 100,000," a figure at least twice as large as the most ardent booster ever claimed as the population of Butte; because there are a few houses that are not exactly like all the rest, he dilates on the wonderful variety of architecture; Columbia Gardens, a commonplace combination of pleasure resort and park, is called "a wonderland of nature," and elicits further praise that makes Butte's best friend blush.

The general impression that the book would leave on the mind of the casual reader is certainly unjust to Butte. The "tenderloin" district, the dope colony, the saloons and gambling houses, fashionable courtezans, corrupt copper barons, heinous blackmailers, hired character assassins, even war profiteers and slackers, are described vividly, and scored roundly. Granting that there are facts to support everything he says—and Butte's admirers will not deny that there are quite a number of blotted pages in her history and a goodly collection of skeletons in the closet—the author is certainly unfair to the "largest mining camp in the world." There is evil everywhere, but there is also honesty and decency everywhere, and Butte is not now, nor has it ever been, an exception. The author of "Sketches of Butte" tells one side only. The book should not be taken too seriously, but, as we have said, it makes interesting reading. A. B. P.

Laboratory Principles

A Textbook of Fire Assaying. By Edward E. Bugbee. Second edition. John Wiley & Sons, Inc., New York. $3.

The author has revised and enlarged his earlier excellent treatise, with consequent improvement. The layout is the same as in the former work, but much useful material has been added, including hitherto unpublished results of research as well as data from other sources. Effort is made to ground the student thoroughly in the principles that underlie the various operations in the laboratory rather than to provide him with a set of recipes which he may be tempted to follow blindly. One must not understand from this that a burdensome amount of theory is given without any practical instruction. On the contrary, the book is intended to guide and instruct the student in his laboratory work, and to this end gives an adequate course of experiments and exercises, with copious explanatory notes. It is in the addition of new research and other data that the expansion of the former edition has chiefly taken place, and the result is that the assayer of experience will find some chapters of considerable interest. A. H. H.

Practical Science for Miners

Mining Physics and Chemistry. By J. W. Whitaker. Longmans, Green & Co., New York. $3.

This is an elementary treatise on physics and chemistry by an English author, intended to serve as a groundwork for further studies in the technology of coal mining. Attention is given to the subjects of air composition and analysis, mine gases, mine waters and explosives, the book concluding with a chapter on coal, gas works and coke ovens. It is written lucidly, and offers much practical information within small space.

The Determination of Sulfur in Iron and Steel. By H. B. Pulsifer. The Chemical Publishing Co., Easton, Pa. $2.50.

This book gives a critical description of the methods in use, together with a large number of detailed analyses. Most of its 160 pages, however, are devoted to a chronological résumé and bibliography of all the published literature on the subject, including that from French and German sources. The book has every appearance of being well done.

SOCIETIES, ADDRESSES, AND REPORTS

Smithsonian Reviews Field Work During 1921

Smithsonian field parties visited during 1921 the Canadian Rockies, Alaska, the Philippines, China and Japan, the West Indies, and Chile, besides many localities in the United States. The preliminary results of this field work are described and fully illustrated in a pamphlet entitled "Explorations and Field Work of the Smithsonian Institution in 1921," which has just been issued. Through its field work, the institution not only carries out one of its main objects, the "increase of knowledge," but also adds much valuable and interesting material to the exhibition and study collections of the National Museum at Washington, D. C.

In the Canadian Rocky Mountains, Secretary Charles D. Walcott continued his geological studies which have been carried on in this region for many years. The particular objects of this season's work were to secure data on the pre-Devonian strata of the Sawback Range in Ranger Brook Canyon, and a reconnaissance of the pre-Devonian formations to the Northwest as far as the headwaters of the North Fork of the Saskatchewan River, Alberta. Although the unusually cold and stormy season interfered greatly with this work, many formations were examined and a large number of fossils were brought back to Washington for study.

Dr. R. S. Bassler, curator of paleontology in the National Museum, spent part of the field season in collecting geological material and in mapping and studying the economic resources of Franklin quadrangle, in Williamson County, Tenn., in co-operation with the Geological Survey of Tennessee. This section is of special interest on account of phosphate and oil shale possibilities.

J. W. Gidley, assistant curator of vertebrate paleontology in the museum, conducted successful field explorations in Arizona.

Astrophysical field work is carried on by the Smithsonian on Mount Harqua Hala, Arizona, and on Mount Montesuma, Chile, these two regions being among the most cloudless in the world. At these two stations are made observations of the sun on every suitable day throughout the year, under the direction of Dr. C. G. Abbott, assistant secretary of the Smithsonian Institution. From the Chilean station daily telegrams are forwarded to Buenos Aires, Argentina, giving the observed value of the solar constant of radiation for the day.

Expeditions covering biology, archeology, and ethnology were also made.

American Iron & Steel Institute Meeting

The twenty-first general meeting of the American Iron & Steel Institute was held at the Hotel Commodore, New York, on May 26. Preceding the opening address by Judge E. H. Gary, the following papers were presented:

"The Development of the Iron and Steel Industry of Australia," by David Baker, general manager of the Broken Hill Proprietary Co., New Castle, N. S. W., Australia; "The Relation of the Doctor to the Steel Plant," by Loyal A. Shoudy, chief surgeon of the Bethlehem Steel Corporation; "Industrial Housing," by C. L. Woodbridge, general superintendent of the Carnegie Land Co., Pittsburgh; "The General Effect of Electrification of Steel Mills Upon Their Operation," by Wilfred Sykes, assistant to operating vice-president of the Steel & Tube Co. of America, Chicago; "The Importance of the Iron Ores of the Adirondack Region," by Frank L. Nason, geologist, New Haven, Conn.; "Methods of Using Fuel in Open-Hearth Furnaces," by Herbert F. Miller, Jr. assistant superintendent of the Lackawanna Steel Co., Buffalo, and "Gas and Air Valves for Open-Hearth Furnaces," by W. C. Bulmer, superintendent of the open-hearth department, Ohio works of the Carnegie Steel Co., Youngstown, Ohio.

In his paper, "The Importance of the Iron Ores of the Adirondack Region," Mr. Nason pointed out that the total iron-ore bearing area of that region is approximately 10,000 square miles. Three operating companies, Witherbee, Sherman & Co., the Port Henry Iron Ore Co., and Chateaugay Ore & Iron Co. are equipped to produce 1,500,000 tons of concentrates annually. At least 750,000 tons of this output will average from 61 to 65 per cent iron, with phosphorus at 0.01 to 0.004 per cent. The crude ore in sight is estimated at 186,000,000 tons, and the prospective tonnage of the region is stated to be 1,736,000,000.

Need for the Gold Standard

An interesting pronouncement of views as to the status of the gold standard was made by D. R. Crissinger, Comptroller of the Currency, when he addressed the Pennsylvania Bankers' Association at Pittsburgh on May 26. Comptroller Crissinger declares that at no time has the gold standard been so necessary as at present. In the course of his speech he said in part:

"We must recognize that political rehabilitation and economic reconstruction are so intimately related that they cannot possibly be separated the one from the other. In both, our country is under necessity to serve civilization.

"Almost the last among great financial communities to commit ourselves definitely to the gold standard, we find ourselves now summoned to determine, for all the world, whether that standard shall be maintained or whether we shall abandon it and allow the economic craft to struggle without chart or rudder.

"During the years of the heated controversy over the gold standard we were constantly being assured that our country was the victim of the gold standard because we were a debtor nation, and others controlled the world's gold. We were told that the tendency was for gold constantly to increase in value, compelling the debtor always to pay in a dearer money than that in which he had borrowed.

"It was not always easy to answer, for effective answer required the consideration of economic fundamentals concerning production, exchange, and consumption. But in 1896, after a campaign of education in these fundamentals, the verdict was in favor of maintaining a gold standard. I am sure that if today the verdict had to be sought again on those issues, the gold standard would win again by a far greater majority.

"In the quarter century since 1896, we have seen that this standard does not mean the economic enslavement of a debtor country; rather, it means the assurance of equal opportunity to develop resources, and the chance to transform the debtor community into a creditor state. In 1896 we were the greatest borrowing community in the world; in 1922 we find ourselves the greatest lending community, the mainstay and reliance of business, of bankers, of nations, of civilization itself, in the effort to weather the greatest storm that ever burst over mankind.

"If the gold standard meant so much of opportunity to us as the great debtor state, how much more must its maintenance mean to us, now that we have become the great creditor nation? Every argument that could be made in 1896, with however much plausibility, against maintaining the gold standard, now applies with a thousandfold more force in favor of rigidly adhering to it.

"We know how absolutely necessary is a uniform monetary standard throughout the world. We know that without it our problems of exchange and of international commerce cannot be solved. We realize that the debts which are owing to us, the balances which must be paid to us or by us, must somehow be adjusted to a single, common, universal standard; and that, as these obligations have all been thus far related to or measured by gold, we cannot safely depart now from that standard.

"The security of the gold standard depends on the maintenance of a free gold market, on the comparatively unrestricted flow of gold. If the movements of commodities shall too long

continue in a particular direction, they must inevitably create a vacuum which can only be filled by a movement in the opposite direction.

"In the last eight years, the movement of commodities has been away from our shores, and the movement of gold has been toward us. The result is that our side of the world tends to gather to itself more than it needs of the gold, while the other side, burdened with debts, finds its store of gold constantly reduced, and its powers to maintain a gold standard correspondingly weakened. The gold standard cannot be maintained by piling up all the gold in one place.

"It has been proposed that a conference of the various national financial establishments be held, to devise measures to restore and maintain the gold standard. In every such discussion it must be kept in mind that the permanency of the gold standard depends fundamentally upon some adjustment or settlement, not cancellation, of all international debts, in terms of gold, so that they can be paid by the contracting parties without sorely impoverishing the people through unbearable burdens of taxes. It is well to remember that the economic possibilities of reconstruction must be measured in units of human energy, and an overload, or a lack of such units, means default and disaster. In every such effort our country must obviously take a part, for we are not only the leading creditor nation but we have become custodian of the greater share of the world's gold."

MEN YOU SHOULD KNOW ABOUT

W. H. Emmons is making a survey of the Ducktown mining district.

Kirby Thomas was in Washington last week conferring with Federal officials.

J. F. Wolff, of Duluth, was recently on the Gogebic Range doing some geological work.

G. T. Jackson, of the Shasta Zinc & Copper Co., recently made a visit to San Francisco.

J. K. Turner, mining engineer, of Goldfield, has gone to New York for an indefinite stay.

W. H. Blackburn, general manager of the Tonopah Mining Co., has gone to Salt Lake City on business.

L. D. Gordon, president and general manager of the Round Mountain Mining Co., has gone to San Francisco.

C. H. Monroe, O. B. Perry, and **J. F. Newsom** are in the Federated Malay States with headquarters at Ipoh.

Dr. A. S. Eakle, professor of mineralogy at the University of California, is visiting mining districts in Nevada.

P. S. Smith is en route to Alaska to make geologic investigations in the region tributary to the Alaska Railroad.

O. B. Hart, superintendent of construction for the Yukon Gold Co., will leave June 3 for the Federated Malay States.

J. B. Mertie, Jr., is en route to Alaska to investigate the gold deposits of the Fairbanks and Rampart districts.

Charles Butters has returned to Oakland, Cal., after a three months' trip in Honduras, Nicaragua, and Salvador.

Dr. C. K. Leith, with a party of students from the University of Wisconsin, is spending a few days on the Gogebic Range.

Raymond Guyer has returned to his home in Spokane after a short trip of inspection to the Cori Gold Mines' holdings in Mexico.

L. A. Dodd, who has been gold commissioner at Barkerville, B. C., for some years, has been transferred to Nanaimo, B. C.

Edward Sampson is to continue work in the Pend d'Oreille district of Idaho in co-operation with the state Bureau of Mines and Geology.

J. S. Lutes, general manager of mines for the Tod-Stambaugh Co., is now in Cleveland to confer with the officials of his company.

R. E. Cranston has gone to New Zealand to inspect the dredge of the Rimu Gold Dredging Co., operating near the town of Hokitika.

G. S. Blaylock, for many years general manager of the Consolidated Mining & Smelting Co., has been elected a director of that company.

J. W. Sherwin, general manager of the West End Consolidated Mining Co. and allied companies, is in Tonopah from Oakland and Las Vegas.

Paul J. Kruesi, a manufacturer of Chattanooga, Tenn., will act as assistant Secretary of Commerce during the absence of **C. H. Huston** in Alaska.

B. H. Stoddard is to do field work in New York, Massachusetts and New Hampshire for the mineral resources division of the U. S. Geological Survey.

R. A. Angst and **E. W. Hopkins** have been in Cleveland attending the meetings of the subsidiary mining companies of Oglebay, Norton & Co.

Waldemar Lindgren has been engaged by the U. S. Geological Survey to make a special report on the geology and ore deposits of the Bradshaw Mountain.

Felix A. Vogel, mine manager for Ladenberg, Thalmann & Co., spent a week on the Gogebic Range, Michigan, accompanied by **Andrew Formis**, superintendent of the Bates mine, at Iron River.

G. R. Mansfield, of the U. S. Geological Survey, is visiting the potash fields of Texas and the borate fields of California. On his return, about the end of June, he will visit some of the eastern phosphate fields.

E. H. Finch, formerly on the Land Classification Board, U. S. Geological Survey, has gone to Central America for several months, for the purpose of making geologic examinations of prospective mineral lands.

M. W. Hayward, chief engineer of the Cia. Minera de Peñoles, has finished his inspection trip and has returned to Monterey to confer with **Heath Steele**. They probably will visit the camp together early next fall.

George E. Deatherage, recently in charge of furnace plant construction for the Indian Iron & Steel Co., of Asansol, India, spoke before the Engineers Club of Northern Minnesota on May 27 at Chisholm, Minn. His subject was "India Industrially."

Glenn L. Allen, specialist in ore concentration, has completed a month's work at the mill of the Minas Pedrazzini Gold and Silver Mining Co., Arizpe, Sonora, Mexico. After June 1 his address will be in care of La Fe Mining Co., Guadalupe, Zacatecas, Mexico.

W. J. Olcott, president of the Oliver Iron Mining Co., also **S. B. Sheldon**, vice-president and general manager of the Minnesota Steel Co., are in New York attending the meeting of the presidents of the subsidiary companies of the U. S. Steel Corporation.

Prof. A. P. Coleman, who, after being thirty years on the staff of the University of Toronto, is resigning his position as head of the Department of Geology and Dean of the Faculty of Arts, was given a complimentary dinner by his colleagues and friends on May 22.

Mining and metallurgical engineers visiting New York City last week included: **Norman Carmichael**, of Clifton, Ariz.; **R. J. Grant**, of Denver, Col.; **David White**, of Washington, D. C.; **John G. Kirchen**, of Tonopah, Nev.; **E. H. Suender**, of Frackville, Pa., and **Thor Warner**, of San Antonio, Tex.

OBITUARY

Frank P. Mills, for several years in charge of the Cleveland-Cliffs Iron Co. interests at Ishpeming, Mich., died at Berkeley, Cal., on May 18. Under his direction the Lake mine, at Ishpeming, was developed.

A. J. Schumacher, of Weiser, Idaho, died suddenly on May 9. Mr. Schumacher was graduated from the Colorado School of Mines, was a member of the A.I.M.E., and for many years superintendent of the Parrot Smelter, at Butte, Mont. Leaving Butte, he bought and operated for some years the Baker City Iron Works, but sold out to develop mining properties in Idaho.

John M. Longyear, mining engineer and capitalist, died at his home, Brookline, Mass., on May 28. Mr. Longyear was born in Lansing, Mich., in 1850. He lived for a number of years at Marquette, Mich., and held extensive lumber and mining interests in that region. He was a member of the corporation of Massachusetts Institute of Technology, and for twenty-five years was a member of the board of control of the Michigan College of Mines.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

REDUCTION of freight rates horizontally, effective July 1, was suddenly announced by the Interstate Commerce Commission on May 24.

Increasing activity among copper producers marks the beginning of June. Moctezuma, North Butte, and Davis Daly have resumed operations, United Verde has started its smelter and the Copper Queen output is to be increased.

Details of the bill of complaint in the suit of Wolf's Mineral Process Corporation against Minerals Separation are given in this issue.

Minnesota's tonnage tax law has been held constitutional.

Decision in the Naica Mining Co.'s case has been reversed by the Mexican Supreme Court.

Formation of an export silver association has been suggested to control the silver market for American producers after Pittman Act purchases are completed.

I. C. C. Orders Horizontal Cut in Freight Rates

Reduction Averages 10 Per Cent, Though Higher on Some Commodities—Effective July 1

A general horizontal reduction of 10 per cent in freight rates below the rates which became effective on Aug. 26, 1920, was ordered by the Interstate Commerce Commission in a decision handed down on May 24. The new rates are to become applicable on July 1. Carriers were requested to notify the commission by May 31 whether the decision was acceptable.

This action of the commission in reducing rates marks the end of the exhaustive investigation begun last fall into the rate situation. It is said that in practically all instances where readjustments and reductions have been made by the commission or voluntarily by the railroads since Aug. 26, 1920, the 10 per cent reduction just granted will replace the earlier readjustments.

Moctezuma Copper to Start Mill

The Moctezuma Copper Co., at Nacozari, Sonora, will start the first unit of its 3,000-ton mill on June 1. Production was suspended April 15, 1921. Since then the concentrator has been remodeled and considerable development work done. It is expected that the unit will produce about 1,000,000 lb. of copper in June.

Hayden Smelter Resumes

At the Hayden smelter of the American Smelting & Refining Co., a reverberatory has been started on Ray Consolidated's copper concentrates. The copper department at the company's El Paso smelter has also resumed work with one furnace.

United Verde Begins Smelting

The United Verde Copper Co., of Jerome, Ariz., has started a reverberatory and will put a blast furnace also into operation soon.

North Butte Ordered To Resume

Announcement was made the last week in May that the North Butte Mining Co., Butte, Mont., would resume operations June 1 after a shutdown since April, 1921. During the shut-down about 100 men have been employed on development and repairs. Anaconda's Washoe smelter will handle North Butte's ore.

Davis Daly's Colorado Mine Again Operating

The Colorado mine of the Davis-Daly Copper Mining Co. resumed work on June 1 with about 300 men. This mine continued operating after other mines in the Butte district shutdown in April, 1921, finally suspending because of difficulty over its smelting contract with the East Butte company. A new contract has apparently been arranged. The company's Hibernia mine has continued in operation, producing silver ore.

International Nickel Reopens Port Colborne Refinery

The refinery of the International Nickel Co., at Port Colborne, Ont., has been reopened, after an extensive shutdown. There are sufficient supplies of matte on hand to keep the refinery in operation for a considerable time, and no attempt will be made to start the smelter at present. It is understood, however, that one or more furnaces will be placed in operation some time during the fall.

Sulman & Picard Broke Contract, Alleged in Wolf's Suit

Used Information Obtained in Making Tests as His Agents to Secure Basic Flotation Patent

In the action brought by Wolf's Mineral Process Corporation against Minerals Separation North American Corporation, the bill of complaint charges infringement of the plaintiffs' patent No. 787,814, of April 18, 1905, and that the licenses granted by Minerals Separation have infringed this patent.

This patent has never been used by the Wolf company, it is stated, nor has its use been permitted, though the company says it has been willing to grant licenses on the payment of a reasonable royalty.

On or about Feb. 5, 1903, according to the bill, Jacob D. Wolf contracted with Sulman and Picard, of London, to test certain processes invented by him for concentrating ores and separating minerals from their ores, and also to construct exact formulas for the most economical and efficient working of the processes on a commercial scale; also to improve the results of the processes and determine the best methods of using them; and to turn over to Wolf the results of their acts. For this Sulman and Picard were to receive a salary of 100 guineas per month.

Sulman and Picard, the bill states, agreed to observe the obligation of secrecy as to investigations and experiments to be made and agreed to make detailed reports and explanations to Wolf of the work done upon the processes, and of all discoveries, inventions, designs, and improvements made or worked out from time to time, or in course of investigation, by them or by their assistants. All such discoveries and improvements were to belong to Wolf absolutely. Sulman and Picard

were to render any assistance in their power to enable Wolf to patent successfully such discoveries and improvements. Wolf's right to acquire any patent under the agreement was to include and extend to all improvements and their extensions.

The agreement further provided that its obligations should be binding upon the executor, administrator, and assigns of each party and that Wolf should be at liberty to assign validly and effectually to any third party the benefit of the obligation of the contract. On April 8, 1922, it is stated, Wolf assigned to Wolf's Mineral Process Corporation all his rights under the contract.

Wolf performed his part of the contract, the bill of complaint states. Sulman and Picard performed it in part by making tests and experiments based upon the disclosure which Wolf had made to them of his processes and by making certain representations and assisting Wolf in preparing and prosecuting his application for a patent.

Sulman and Picard, it is alleged, broke the contract by concealing from Wolf certain of the results derived from their experiments and by disclosing the processes and results of the experiments made under the contract to other persons. It is alleged that they caused or permitted Sulman, Picard and (John) Ballot to apply for and obtain U. S. patent 835,120, dated Nov. 6, 1906, for certain new and useful improvements in ore concentration, which improvements were the result of Wolf's invention and were developed by Sulman and Picard under Wolf's direction and as his agents.

Sulman and Picard, it is further alleged, caused and permitted this patent and others, United States and foreign, to be taken out in the name of other persons than Wolf, and refused and neglected to assign them to Wolf, although such assignment was duly demanded.

The patentees, it is further alleged, then wrongfully assigned or attempted to assign patent 835,120 and other patents of which Wolf was the equitable owner to Minerals Separation, Ltd., which was organized at the instance of Sulman and Picard. They were then assigned by Minerals Separation, Ltd., to Minerals Separation American Syndicate, Ltd., which in turn assigned them to the defendant Minerals Separation North American Corporation. The defendant, the bill states, is the assignee of the obligations of Sulman and Picard under their contract with Wolf.

Discovery of the amount of royalties and profits made by the defendant under patent 835,120 is asked.

The plaintiff further requests (1) a writ of subpœna requiring the defendant to appear; (2) an injunction against the infringement of the plaintiff's patent 787,814; (3) an injunction asking the assignment of patent 835,120 and all other patents including any invention or discovery or improvement made by Sulman and Picard or associates in the course of their experiments for Wolf under contract; (4) an accounting of profits; and (5) that plaintiff recover the profits.

The Wolf's Mineral Process Corporation and Wolf, it is alleged, were unable to ascertain the fact that the defendant was infringing. They state that they have been prevented from previously bringing action by the acts of the defendant and by the financial inability of Wolf.

Naica Mining Co. Decision Reversed

The Supreme Court of Mexico has rendered a unanimous verdict in the appeal of certain shareholders of the former Naica Mining Co., against a previous decision disbanding the company. Eight months ago the Supreme Court handed down its decision adverse to the Naica company, in favor of the Stopelli heirs, who had alleged irregularities in the company organization and asked for a return of the property and an accounting.

The Naica is one of the richest silver-lead producers in the republic. The company was organized with only eighty shares, which have reached at times a market value of $25,000 per share. The case has been extremely sensational and led to a number of the American stockholders appealing to the American State Department. Serious charges were also made against three of the Supreme Court judges, including the president, and a special grand jury of the Mexican congress has been instituted to investigate.

A portion of the mine, not affected by the decision, is still operating.

Mexican Government Objects to Durango Mine Tax

There has been a sharp interchange of notes between the Secretary of the Treasury, in Mexico City, and the Governor of the State of Durango, caused by the recent imposition of a special state mining tax of "2 per cent per hundred." The federal government says that the intention of the tax is vague and subject to various interpretations, in the first place, and illegal in the second, the central government reserving itself the right to tax mines, oil, coal or other minerals which primarily belong to the nation at large.

Nichols Copper Co.'s Plant Damaged by Fire

The plant of the Nichols Copper Co. at Laurel Hill, New York City, was damaged to some extent by fire on May 27. The anode plant was destroyed, this being the principal loss. At the office of the company it was stated that newspaper reports of the accident were greatly exaggerated, and that there would be no serious interference with the company's copper production as a result of the incident. The fire had its origin in a spill at one of the furnaces.

Minnesota Tonnage Tax Valid, Judge Johnson Holds

Rules It Is Constitutional—Companies to Appeal

In a decision handed down by Judge Tillman D. Johnson, of Salt Lake City, in U. S. District Court at St. Paul, Minn., on May 24, the constitutionality of the Minnesota occupational, or so-called tonnage, tax was upheld. This is a blow to the iron-ore producers of the northern part of the state, who sought to obtain a permanent injunction restraining the state from collection of the tax. More than thirty mining companies, including the Oliver Iron Mining Co., subsidiary of the U. S. Steel Corporation; the Republic Iron & Steel Co.; the Cleveland-Cliffs Iron Co.; the Interstate Mining Co.; and the Bennett Mining Co., were involved in the litigation.

Attorneys for the mining companies state that they will appeal the case to the U. S. Circuit Court of Appeals. Pending this appeal a temporary injunction against collection of the tax, granted by Judge Booth, of St. Paul, will remain in force.

Increasing Copper Queen Output

The output of the Copper Queen smelter, at Douglas, Ariz., is to be increased from 6,250,000 lb. of copper per month to about 7,500,000, according to a recent announcement by D. D. Irwin, superintendent of the Copper Queen branch of the Phelps Dodge Corporation.

Keating Wins from Inland Steel

An award of $44,618 has been made to the Thomas Keating Co. by the jury in the case of Thomas Keating Co. vs. Inland Steel Co. This award was based on the estimate made by the plaintiff's engineer of the extra cost of reopening the mine concerned under the conditions existing.

Appeal will be taken to the higher court by the Inland Steel Co.

Thomas Keating was the original fee owner on a forty-acre tract of mining land on the Cuyuna Range near Crosby, Minn., which he leased to George H. Crosby and which was subleased to the Inland Steel Co., and later developed as the Thompson mine, opened in 1912. The operators abandoned the lease in 1919 as an unprofitable operation. Keating is now suing the operating company for upward of $300,000 damages which he is alleged to have suffered through use of improper mining methods, through the intermixing of merchantable iron ore with sand on a waste dump, through the filling of the open pit with overburden removed in subsequent stripping operations, and through the leaving of the underground workings in an unsatisfactory condition.

The decision establishes a precedent which is expected materially to affect the future relations of fee owner and mine operator in the district.

News from Washington

By PAUL WOOTON
Special Correspondent

Cyanide Restored to Free List

Senate Makes Better Progress With Metal Schedule—Rates on Zinc Oxide, Graphite, Fluorspar and Other Products Adopted—Duty Asked on Petroleum

FOR the first time since the tariff bill has been under discussion, the Senate overrode the Finance Committee when it voted, 46 to 14, to restore cyanide to the free list. Chairman McCumber, of the Finance Committee, actively assisted by Senator Frelinghuysen, of New Jersey, made a hard fight to hold in the bill 10 per cent ad valorem duty on "potassium cyanide, sodium cyanide, all cyanide salts and cyanide mixtures, combinations and compounds containing cyanide."

The amendment transferring cyanide from the dutiable schedule to the free list was introduced by Senator Oddie, of Nevada, who contended that the gold mining industry is entitled to free cyanide. Senator Frelinghuysen, in opposing the amendment, established, beyond fear of contravention, the fact that the officers and employees of the Roessler Hasslacher Chemical Co. were entirely loyal throughout the war. Senator Sterling, of South Dakota, did not question the loyalty of the company during the war, but stated that, in addition to its being the only producer of cyanide in the United States, it has intimate connection with the interests which control cyanide production in Germany and in England. Senator Pittman declared that, regardless of opinions, one way or another, about the Roessler Hasslacher company, certain facts are uncontroverted. These he stated to be as follows:

That the control of the stock now is in the hands of the Alien Property Custodian; that the company was organized by two men sent to the United States by the German syndicate; that the company has had no competition in the manufacture of cyanide since its establishment in 1885; that the concern always has been and now is the exclusive manufacturer of cyanide in this country; that it is the sole distributor of imported cyanide; that it "manufactures at this end of the line when it pays to manufacture here and sells here the German stuff when it pays better to sell the German stuff."

Rapid progress was made by the Senate in passing on the items in the metal schedule of the bill. In one day the Senate adopted the committee-rates in the first five paragraphs of the metal schedule, in contrast to previous procedure, which usually disposed of only one item a day in the tariff bill.

On motion of Senator Smoot the proposal to place manganese ore on the free list was deferred for action later.

Following extended debate in which the rates were attacked by Senator Jones, of New Mexico, the Senate adopted the provisions of the bill with respect to zinc-oxide. The rates adopted are 1¾c. per lb. on zinc oxide and leaded zinc ores containing not more than 25 per cent of lead; ground or mixed with oil 2¼c. per lb.; lithopone 1¾c. a lb.

Senator Johnson, of California, introduced an amendment making the duty on unwrought and unmanufactured diatomaceous earth at $1.50 a ton and on wrought or manufactured diatomaceous earth at $3.25 a ton.

Senator Harreld, of Oklahoma, introduced an amendment imposing a duty of 35c. a barrel on crude petroleum and 25c. a barrel on fuel oil.

The duty of 2c. a pound on antimony as regulus or metal was adopted, notwithstanding opposition by Senator Jones, of New Mexico.

The Senate also adopted the duties recommended by the committee on lime, limestone, plaster rock or gypsum, pumice stone, and bauxite.

Senator Jones, of New Mexico, sought to reduce the duty on fuller's earth from $3.25 to $1.50 a ton, but the Senate adopted the higher rate.

After extensive debate the Senate adopted the graphite rates as recommended by the Finance Committee, as follows: Amorphous graphite, 10 per cent ad valorem; crystalline, 20 per cent, and flake 2c. a pound.

Senator Jones opposed increasing the duty on fluorspar from $1.50 to $5.60 a ton but the increase was adopted by the Senate, Senator McCumber explaining that it was desirable to protect this mining product, although mining interests had asked for from 50 to 60 per cent higher duties.

Amendments to the bill introduced by Senator Poindexter, of Washington, propose to change the duties crude magnesite from ⅛c. per lb. to ½c. per lb., and on dead-burned and grain magnesite from 1/10c. a lb. to ¾c. a lb.

On motion of Senator Smoot, the Senate reduced the duty on strontium from 50 to 25 per cent ad valorem, on the ground that the product is virtually controlled in this country by one concern.

The Senate also adopted the duty of $1.50 on glass sand, after defining that product as sand containing 99 per cent or more of silica.

The mica duties were adopted, following opposition of Senator Walsh, of Montana, who objected to the higher duties on manufactured mica.

The talc duty was also adopted, following opposition expressed by Senator Myers, of Montana, whose amendments to reduce the duties were rejected.

The duty of 25c. a pound on quicksilver was adopted by a vote of 30 to 25. Senators Johnson and Shortridge, of California, urged a 35c. duty, but their attempt to reject the committee rate was defeated.

Coates & Tweed Get Award Under Amended War Minerals Act

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commissioner has made the following recommendations: Coates & Tweed, Duluth, Minn., $59,323.20; Gordon & Emery, Yreka, Cal., $548.81; Robert Brown, Elko, Nev., disallowed, non-commercial; C. E. Groce, Blythe, Cal., disallowed, stimulation not established; F. M. Knight, Prairie City, Ore., disallowed, not within the act; Eleanore Manganese Co., Butler, Tenn., $1,243.35; H. B. Greever, Bluefields, W. Va., $5,626.67; Audley H. Stone, Bluefields, W. Va., $8,568.97; Edmond Putnam, Johnson City, Tenn., $899.18; Holter & Faucher, Grants Pass, Ore., former award ample; Gose Mines, Burk's Garden, Va., former award ample; Herbert W. Smith, Washington, D. C., $4,158.94; John Madrid, Angels Camp, Cal., insufficient evidence; W. S. Crammer, Fresno, Cal., not commercial; Louis L. Cleaner, Prairie City, not within the act; Carolina Chrome Co., Waynesville, N. C., previous award ample; W. H. Shewan, Fanning, Nev., prior award ample; Herman Neipp, Blythe, Cal., not commercial.

In the case of Coates & Tweed, losses aggregating $81,631 were claimed. The entire amount was disallowed by the original War Minerals Relief Commission, but under the amended act, the company was able to establish stimulation and an award, as set forth above, has been recommended.

Mine Law Hearing Again June 8

Further hearings on the revision of the mining laws proposed in the Arentz bill will be given by the House Committee on Mines and Mining on June 8, when H. V. Winchell, a member of the engineering committee which drafted the measure, and possibly H. G. Moulton, of New York, and Representatives Raker, of California; French, of Idaho; and McArthur, of Oregon, will be heard.

Interior Department Economizes

Secretary Fall has reported to the President that through various economies the Department of the Interior has saved $936,416 this year as compared with expenditures last year. In the Bureau of Mines, he says, there has been a saving of $52,995.

Export Silver Association Suggested

Would Protect Market for American Producers After Pittman Act Purchases Have Been Completed, It Is Said

Formation of an export silver association along the lines of the Copper Export Association has been proposed by the American Gold and Silver Institute as a means of protecting the future market for American silver when the purchases authorized by the Pittman Act have been completed. Discussing the proposition, H. N. Lawrie, the managing director of the institute, among other things, says: "An effort should be made to develop an export association similar to that organized for the purpose of marketing the copper production of the nation to better advantage. Most silver producers are forced to market their product immediately in order to develop income wherewith to meet operating costs. A silver export association properly organized to extend credit to the producer would make possible a more orderly marketing of the silver production of the country. This, of course, is not a factor at the present time, for the reason that the international price is below the Pittman price.

"The London control of the price of silver has been sustained largely because of the speculative demand for the metal for delivery in the Orient. This is a factor which must not be overlooked in anticipating the success or failure of an export association here. There must be a liquidating market, and unless the speculator will come to the rescue of the market, as he has in supporting the London market, there will be difficulty in operating such an association. A strong association, capable of purchasing the entire world's production of silver, would be in a unique position to force the speculator to come to it for accommodation. The United States and Mexico produce 70 per cent of the world's silver. This country should assume a stronger position in determining the market. It also might develop to be of great assistance to such an export organization if the co-operation of the Standard Oil Co. and other American companies, who transact large volumes of business in the Orient, were to co-ordinate closely their bullion operations with those of the silver association."

Bill To Validate Placer Patent Introduced

To meet the recent decision of the U. S. Supreme Court which invalidated placer mining patents in the Red River region of Oklahoma and Texas, Representative Oldfield, of Arkansas, has introduced by request a bill authorizing the Interior Department to issue placer-mining patents to cover claims heretofore made in good faith. The bill points out that the Melish Consolidated Placer Oil Mining Association made placer-mining entries in good faith prior to Oct. 1, 1919, on land belonging to the United States in the south half of Red River, Oklahoma, and brought in discovery wells demonstrating the presence of oil. It recites that the Supreme Court has held that the land was "not technically subject to the mining laws of the United States."

Helium Embargo Proposed

Legislation proposing an embargo on helium exports, which is soon to be considered by a committee of the House of Representatives, differs from embargoes on commercial articles, it is pointed out, in that helium is primarily a weapon of warfare. Moreover, it is a weapon on which the United States has a monopoly. It seems to be the consensus of opinion among Army and Navy officials concerned with helium that it would be entirely foolish to allow the exportation of this gas to a possible enemy.

The helium bill, it is further pointed out, does not put the Government into business. There are numerous precedents in which the Government develops fundamental facts and brings a process to the point where it can be developed commercially. In the case of helium, the cost of experimental work and the uncertainty as to its outcome, would have precluded for an indefinite period any exploitation of the helium resource by private capital.

News by Mining Districts

London Letter

Katanga's Position—Fanti Consolidated's Contract Canceled—Electrolytic Zinc Co. Busy.

BY W. A. DOMAN

London, May 19—Although the Union Minière du Haut-Katanga has never under-rated the magnitude of its mineral concession, it is questionable whether the management has hitherto quite appreciated the fact that to develop the copper deposits successfully, the capital expenditure must be upon an ever-increasing scale—at least there seems no likelihood of its ceasing for some time. As one of the directors pointed out at the recent meeting of shareholders, the board simply cannot stop; development must go on. The possibilities are so great that to call a halt now would be to endanger the future.

The company has raised on share issues 40,000,000 fr.; on debentures, 60,000,000 fr.; secured creditors amount to 5,000,000 fr., and unsecured creditors exceed 70,323,000 fr. and bills payable figure in the balance sheet as on Dec. 31, 1920 (the latest issued) at 1,118,630 fr.

By an agreement with the Special Katanga Committee, the mineral concessions have been prolonged to March, 1990. To carry out the program for the treatment of the low-grade ores, it is estimated that a further 300,000,000 fr. will be required. As the Tanganyika Concessions' fortunes are bound up with those of the Union Minière, the former had the right to take up 43,248 capital shares at 400 fr. each, and to receive 20,000 dividend shares free in new capital to be issued by the Union Minière. As the Union Minière was unable to pay a dividend, having to provide about 10,000,000 fr. for depreciation, Tanganyika shareholders also get no return upon their investments. That their time will come, however, seems certain, but the production scheme must be made secure first. The Union Minière now produces about 100 tons of copper a day—something of an achievement in Central Africa. The intention is, of course, to proceed by stages to 100,000 tons per annum. The Union Minière has continued operations while most other large producers of copper had to shut down. In 1914 the output was 10,722 tons; last year it had reached 30,470 tons. The electro-leaching test plant has proved satisfactory, and shows that the leaching process is the most suitable method for treating the low-grade ores of Katanga. Copper ore reserves on Jan. 1 last were estimated to be 49,006,000 tons of ore, carrying 2,830,000 tons of copper.

At the annual meeting of shareholders of Fanti Consolidated (Gold Coast Colony, West Africa) in May, 1921, it was stated that a contract had been entered into for the sale of 500,000 tons of manganese ore, deliverable at the rate of 100,000 tons per annum, with a guaranteed minimum profit of 7s. 6d. per ton. At the meeting of shareholders on May 16, Edmund Davis, the chairmman, said the contract was canceled because difficulties had arisen over its interpretation, and, in particular, those relating to items chargeable to working costs previous to arriving at the guaranteed profit. The matter is quite clear, of course, but the question has been asked why the basis was not worked out and agreed upon before the contract was made.

The Electrolytic Zinc Co. of Australasia is now getting to work. The full plant of 30,000 hp., with an output capacity of 45,000 tons of zinc per annum, is expected to be running in July. The company has spent in six years approximately £3,000,000, and the government of Tasmania over £1,000,000, in experimental, development and construction work. The company purchased 750,000 tons of zinc concentrates from the British government, and there is over 100,000 tons of high-grade ore in reserve in the company's own local properties, and approximately 12,000,000 tons of reserves at the

Broken Hill mines. The British government has agreed to purchase 45,000 tons of spelter per annum for a period of years, and, in addition, the company expects to produce over 125,000 tons of sulphuric acid and 15,000 tons of leaded zinc oxide.

Development in the Geduld Proprietary Mines was of such a satisfactory nature last year, about 863,000 tons, which raised the value of the whole 3,545,000 tons of reserves by 0.1 dwt., and the width by 1 in. to 8.1 dwt., over a stoping width of 62 in., that the directors have decided to increase the milling capacity. The nominal capacity of the present reduction plant is 40,000 tons monthly; and it is to be raised to 65,000 tons. This is a step in the right direction, for the property is a large one, and the management has hitherto proceeded very cautiously in the matter of expansion. Their object has evidently been to prove the property first.

CANADA

British Columbia

Shutdown of Dolly Varden Railroad Hinders Work in Alice Arm District

Alice Arm—Mining men and prospectors of the Alice Arm district are in difficulties because of lack of transportation up the Kitsault valley. The Dolly Varden R. R. has been closed down, and the company does not appear to be prepared to maintain a service this season. The provincial government has been asked, it is understood, to take such steps as are necessary to provide the operators of this section with the means of transporting supplies and ore from mines and prospects to tidewater. There is no present indication of how the problem is to be solved.

Kaslo—Preliminary operations incidental to resumption at the Cork-Province mine, on the South Fork of Kaslo Creek, are well under way.

Sandon—The flotation plant of the Silversmith mill has been in operation since May 9, and is reported to be working satisfactorily, with an indicated output of 400 tons of zinc-silver concentrates per month. The output will run 50 per cent zinc, with 35 oz. silver per ton. The concentrates will be stored pending arrangements for shipping to Trail. The other section of the mill is now producing 500 tons of silver-lead concentrate per month. The silver-lead output is netting the company about $90 per ton, and net shipments to date this year approximate $200,000. It is said that dividend payments will start in July, and be maintained regularly on a monthly or quarterly basis.

Trail—Ore received at the Consolidated smelter May 8 to 14 inclusive totaled 7,701 tons, of which 7,107 tons came from the company's mines. The other shippers were: Utica, Adamant, 27; Florence, Princess Creek, B. C., 72; Mountain Chief, West Robson, B. C., 100; Quilp, Republic, Wash., 115; Standard, Silverton, B. C., 193; and Silversmith, Sandon, B. C., 87.

Ontario

Coniagas Option on Newray Ratified—High Heads Continue at Dome

Cobalt—The Coniagas' option on the control of the Newray mine, in Porcupine, at a price of 35c. a share, has been ratified, and diamond drilling will be started at once. The company has to spend $4,000 a month during the life of the option.

Two more veins, carrying some silver, have been cut in the shaft of the Victory mine at a depth of 430 ft.

The 1921 report of the Mining Corporation shows a severe decline in both production and profits, as compared with the previous year. Total revenue was $578,913 from 1,226,717 oz. of silver, and gross profits were $23,420, compared with $651,461 in 1920. After deducting $63,367 for income taxes, there was written off $232,939 loss on Canadian Industrial Minerals Ltd., which was formed to supply war minerals, and $231,023 loss on optioned properties, giving a net loss of $522,-434. The company's exploration department covered North and South America, Europe, and Asia, but the best results have been obtained in northern Ontario. The Buffalo purchase turned out to be important, and the Frontier, in South Lorraine, is developing well. The average grade of ore for the year was 20 oz. and cost per oz was 84.64c. Quick assets are given as $1,191,440.

During the week ended May 19 there was no shipment of ore from Cobalt.

Porcupine—The Holtyrex, which adjoins the McIntyre, has let a contract for 3,000 ft. of diamond drilling. The company has been successful in marketing its stock, and has a considerable amount of cash on hand.

The Clifton-Porcupine has been successful in marketing 170,000 shares and work on the property has been resumed. It is said that a small mill will be built.

A report from the Davidson is to the effect that diamond drilling at a depth of 1,200 ft. cut 25 ft. of ore averaging $7.12. It is understood that the London flotation has not been successful and that about 80 per cent of the stock has been turned back to the underwriters.

High heads are continuing at the Dome, and it is understood that the company is considering the repayment of $2 a share on capital account.

A company has been formed to take over the McLeod property at Night Hawk Lake. Developments at the Peninsular have been satisfactory.

Quebec

The asbestos industry of Quebec province has been seriously affected by the falling off in the demand for asbestos in 1921, in consequence of which the output is being greatly curtailed. Practically all the properties in East Broughton and Robertson are closed down, and in the Thetford and Black Lake districts production is on a greatly restricted scale.

MEXICO

Explosives Importing Bill Awaits Signing—Prospecting for Diamonds—Inquiries for Machinery Increase

Mexico City—A decree of vital interest to the mining interests in Mexico authorizing the free and unrestricted importation of explosives is awaiting the President's signature. For several years, owing to revolutionary activities, the importation of explosives has been in the hands of the War Department, and an almost intolerable amount of red tape and frequently "grease" was required to keep the mining camps supplied. Often plants have been obliged to close for weeks at a time because of their inability to get the necessary explosives. Under the proposed ruling, responsible companies will be permitted to import without any restrictions or delays, the government requiring them to make a statement from time to time of quantities received and how and when used.

After a lapse of several years the American press is carrying stories once more of the discovery of diamonds in the State of Guerrero. These reports are based on the alleged discovery of diamonds in that section, just a hundred years ago, by the revolutionary general, Vicente Guerrero. The location is usually given as in the vicinity of Tetela del Oro, in the Sierra Madre range of mountains, southern Mexico.

The republication of these diamond stories has actually started some prospectors on the trail again. Within the past few weeks two small parties have outfitted from this city, and one from the Port of Acapulco. Guerrero is a highly mineralized state, and if the diamond seekers fail in the main purpose, they may find something else to their taste and profit.

Dealers in and agents for mining machinery report a strong increase in the number of inquiries and requests for estimates on mining machinery.

Apparently, most of the inquirers are accumulating figures for their budgets, having in view an early resumption of work or the opening up of new properties. The trend of the inquiries show that the latest ore treatment processes are being considered, and that plans are being made in many instances to treat large quantities of low-grade ores.

Durango

Promontorio Ore Not Amenable to Flotation—Cerro de Mercado Survey Finished

BY ALBERTO TERRONES BENITEZ

Guanacevi—The Cia. Minera de Sultana y Anexas has decided to start work at its properties at San Pedro adjoining the Soto mines. Ignacio Bolivar will be in charge.

Hilario Losoya is negotiating for the installation of an hydro-electric plant near Carrizo, for which a survey has been made.

Reginaldo Cepeda, manager of the Cia. Exploradora de Guanacevi, is planning to install a gas plant at the San Rafael mines.

Santiago Papasquiaro—The Sauces Mines & Milling Co. has finished installation of a fifty-ton mill at Sauces near the Tepehuanes railroad terminal. The mill is now treating ores from the Santo Nino and Nopal mines of the company. The concentration ratio is 20 to 1. It is using a Ruth flotation machine, and by the use of sodium sulphide the operators expect to increase the extraction to 85 or 90 per cent. Ore and concentrates are being shipped to the Asarco smelter. At present there is a shortage of labor.

Flotation experiments at the Promontorio mill proved that the ores were not suitable for that process. This is probably due to the fact that the operating company is now treating oxidized ores from the dumps and the upper levels. Operations are still going on. Max Damm is personally in charge.

Durango—Geologists of the Geological Institute of Mexico City have finished their survey of the Cerro de Mercado and of the surrounding country. This is the first important geological survey ever undertaken in Durango, and it is planned to continue the work all over the state. Two geologists and a petrographer will be sent to Guanacevi next October.

According to official reports, an announcement has been made by the federal government to the effect that free importation of explosives and machinery used in mining will soon be decreed.

CALIFORNIA

Original Sixteen-to-One Makes Strike —Estabrook Dredge May Not Resume

San Francisco Correspondence.

San Francisco—Recently the Original Sixteen-to-One mine, in the Alleghany district, Sierra county, made a rich gold strike, and $250,000 was taken out in drifting 50 ft. through the the oreshoot. No stoping was done, and only the ore in the development work was removed.

The Strode gold mine, near Carrville, Trinity County, has been sold to the Strode Mines Co., an Arizona corporation.

The dredge operated by the Pacific Gold Dredging Co., near Trinity Center has been shut down. It appears likely that the Estabrook dredge which was to have been started up will not resume.

At French Gulch, Shasta County, leasers have started milling at the Brunswick mine. Both the Washing- and the Shasta Hills mines are active.

At Graniteville, Sierra County, a quartz vein of promise has been opened at the Eureka mine. The Plumbago mine, near Downieville, Sierra County, will be reopened. Hugh McCormick is superintendent. Pay gravel has been struck in the Gold Lead placer at North Bloomfield, Nevada County.

NEVADA

Simon Roasting Plant Completed— United Comstock's Crew Two-Thirds Normal

From Our Special Correspondent.

Virginia City—No further information has been given out regarding future plans by the Middle Comstock Mines Syndicate, which holds an option on the Middle Comstock group. It is understood that the Paramount Comstock Mines Co., vendors of the property, with permission of the option holders are running a crosscut from the north drift in Savage ground.

Labor conditions underground in the Gold Hill property of the United Comstock Mines Co. are gradually adjusting themselves. The men are returning to work, and the underground crew numbers about 200 men, which is approximately two-thirds of normal.

Mina—The roasting plant at Goldfield is completed, and the Simon Silver-Lead Mines Co. is now shipping its zinc concentrates there for preliminary treatment before shipping to the zinc-oxide plant at Harbor City, Cal. About 1,500 tons of concentrate has accumulated at the mine, content being approximately 44 per cent zinc, 5 per cent lead and 4 oz. silver per ton. The lead concentrate is being shipped to Utah smelters, as usual. Daily tonnage treated is 200, with a production of approximately twenty tons each of lead and zinc concentrates.

The West End Consolidated Mining Co., which holds an option on the Mabel mine, is preparing to sink the shaft to the 300 level. Development work to the west continues to disclose ore, but development to the east toward the old Garfield mine has been disappointing, and work has been stopped in that direction.

Tonopah—Operations in this district are normal, and production is as usual, as indicated by recent bullion shipments. For the first fifteen days of May, shipments were: Tonopah Belmont, $116,000; West End, $86,000; Tonopah Extension, $63,000; and Tonopah Mining, $52,000.

Divide—A body of sulphide ore has been discovered on the 500 level of the Tonopah Divide mine about 600 ft. southeast of the shaft. A winze is being sunk and is down 20 ft. in ore of good grade. The ore carries higher proportionate values in gold than is usual throughout the Divide mine. Net receipts from 1,564 tons of ore shipped during April were $43,872, an average of $28.05 per ton.

Pioche—Shipments for the week ended May 25 are showing a greater variety of producing mines, and in the next ninety days the total should be doubled. Production was: Bristol Silver, 240 tons; Black Metals, 100; Consolidated Nevada Utah, 140; Prince Consolidated, 50; Hamburg, at Highland, 45; total, 575 tons.

The Tempa Mining & Milling Co. expect to start construction of a seventy-five ton mill soon at Fay, twenty-five miles from Pioche.

WASHINGTON

Rich Silver Shipment Made from Old Dominion

Colville—Two carloads of rich silver ore are being sacked for shipment at the Old Dominion mine, near Colville. The management has announced that the shipment will assay 1,100 oz. of silver per ton, and the gross value of two cars is estimated at $80,000.

The Old Dominion is a well-known producer of early days, and is credited with a production of $600,000. It has been practically dormant for twenty years until reopened about a year ago by W. H. Linney. The ore occurs as irregular replacements in limestone and the body which is yielding the high-grade was found about six months ago at a depth of 700 ft. The new development work is being financed by local capital.

Northport — The Washington Black Rock Mining Co. has shipped four cars of high-grade zinc ore recently. These shipments are going principally to Trail smelter. This ore is coming from shaft sinking operations. A new level will soon be opened for stoping.

A discovery of a large body of high-grade gold ore is reported at the Mountain View mine, near Myers Falls, Stevens County. It is understood that the mineralized area was narrowly missed by former operators. The oxidized surface ores carry sufficient values to permit shipment in crude form, and three shifts are now employed getting out the ore.

The Republic mine, a gold producer of the Republic camp, Ferry County, has resumed shipments of crude ore to the Trail smelter.

Chewelah—A car of high-grade crude ore shipped recently by the United Silver-Copper mine netted the company $3,016. Values ran $61.82 silver and $19.90 copper per ton.

OREGON

Bay Horse Mine Continues Crude-Ore Shipments

Huntington—Shipments of crude ore from the Bay Horse mine are being made at the rate of two cars per week, and it is anticipated that three cars per week will be the regular output soon. The ore is going to the Bunker Hill smelter at Bradley, Idaho.

IDAHO

Callahan Zinc's Subsidiary Has High-Grade Ore

Wallace—The ore recently cut by the Galena Mining Co. in the No. 6 tunnel lead at a point 25 ft. above the shaft collar assays 18 per cent lead and 13 oz. silver across the full 4-ft. face of the drift. This ore has now been proved from the 400 level, thus giving a back of 425 ft. It is being drifted on to the east. The point cut is 550 ft. below the crest of the hill. The Galena Mining Co. is a consolidation of the Chicago-Boston and the Killbuck properties. Control is owned by the Callahan Zinc-Lead Co.

ARIZONA

McCracken Silver-Lead Property Sold to Satisfy Judgment

Kingman—The property of the McCracken Silver-Lead Co. has been sold to satisfy a judgment of $13,000. The mine lies in the McCracken Mountains of Mohave County, Ariz. Execution to satisfy a judgment of $21,000 has been issued against the property of the Globe and Lost Gulch Silver-Copper Mines Co. in Gila County, Ariz.

COLORADO

Pactolus Company Building Dredge on South Boulder Creek

Rollinsville—After a year or more of exploration with the churn drill and by test pits, the Pactolus Gold Dredging Co. is installing a dredge on South Boulder Creek, near Rollinsville, in Gilpin County. The company is composed of California interests, and the management is under A. A. Clark, formerly with the Yuba Manufacturing Co., of San Francisco.

The company estimates that its holdings on Boulder Creek comprise 6,000,000 cu.yd. of workable gravel. The hull of the dredge has been completed, and equipment is being installed. Gravel will be lifted to the dredge by a steam shovel mounted on a Holt tractor. The capacity of the dredge is 2,000 cu.yd. in twenty-four hours. Electric power will be used.

A second dredge is being installed on the Gamble Gulch placer, about two miles distant, which will be operated by an allied organization under the name of the Oro Dredge Co. It is estimated that the dredge will handle about 1,200 cu.yd. daily and that the holdings comprise 2,500,000 cu.yd. of workable ground. The depth to bed-rock on both the Pactolus and the Gamble Gulch placers is from 10 to 25 ft.

Montrose—The Western Colorado Power Co., serving the mining camps and towns of the San Juan district, announces that it will expend $130,000 this summer in extending its transmismission line from the Camp Bird mine, in Ouray County, to Montrose, in Montrose County, where the line will connect the hydro-electric plant with the steam-generating plant at this place. Increased demand for power at the mines, smelter, and various towns has necessitated the movement to obtain auxiliary generating facilities.

MONTANA

Walkerville—Shipments of ore from the Goldsmith mine of the Crystal Copper Co., whose property is situated north of Walkerville, have been showing increased values in gold and silver from the 600 level. It is planned to sink to the 1,000 level. Three cars assayed respectively as follows: 43.2 oz. of silver and $7.20 in gold; 57.2 oz. of silver and $9.60 gold; and 45.7 oz. of silver and $5.60 in gold, the value of the three cars totaling slightly more than $7,000.

UTAH

Park City Mining & Smelting Corporation Files Articles

Park City—Shipments for the week ended May 19 were 2,411 tons. Shippers were: Silver King Coalition, 766 tons; Ontario, 708; Park-Utah, 503; Judge, Daly, and Daly West, 434.

The new milling plant of the Silver King Coalition is treating about 250 tons of ore daily, and producing seventy to seventy-five tons of concentrates.

Production by the Park-Utah, Park City's new producer in the eastern and hitherto undeveloped section of the camp, for the week ended May 19 (503 tons) was twice as much as that for the week preceding.

Articles of incorporation for the Park City Mining & Smelting Co., a Colorado corporation, have been filed with county and state authorities. The company has a capitalization of 1,500,000 shares of non-assessable stock of a value of $7,500,000. All the property and assets of the Daly West Mining Co. are stated to have been conveyed to the new corporation, and it is expected to take in the Judge Mining & Smelting Co., whose stockholders have responded favorably to the plan of a merger, on a basis of 1½ shares of stock in the new company for one share of Judge stock. Directors of the new company are: Otto Luedeking, Cincinnati, Ohio; Adolph G. E. Hanke, New York; Harry M. Stonemetz, Boston; Oscar N. Friendly, Park City; G. W. Lambourne and Edward Rosenbaum, of Salt Lake City. Officers are: G. W. Lambourne, president; M. C. Fox, treasurer; O. N. Friendly, manager; D. C. Murphy, secretary and assistant treasurer, and W. A. Dunn, assistant secretary. The new merger offers the advantages that its financial rating will be larger than that of the combined ratings of the companies going to form it (owing to the fact that operations can be coordinated and carried on on a more extensive scale); that, owing to the coalition of interests, some of the tax burdens will be eliminated; and that the properties will be placed on a more uniform earning basis.

MICHIGAN

The Copper Country

New Baltic Shaft in Well Mineralized Ground—Mayflower Cuts Lode 1,450 Level

BY M. W. YOUNGS

Houghton—Quincy is producing approximately 1,500,000 lb. of refined copper per month. This includes mass copper, which constitutes almost one-fourth of the output. Quincy has long been noted for the quantity of its mass. The company is making a good record in its No. 1 stamp mill in recovering copper from the tailings. It has reduced losses to about 4½ lb. per ton of rock stamped. Quincy's yield from vein rock is about 17 lb. per ton, mass copper bringing this up to 22.12 lb. in 1921.

The south drift at the 1,100 level of Arcadian Consolidated's New Baltic shaft continues in highly mineralized ground. The miners are in over 50 ft. in this rich zone, and there is no change in the character of the rock. The vein is 10 to 12 ft. wide and is heavily shot with copper, the showing being considered the equal of any ever uncovered in an amygdaloid lode in the Lake district. To the north of the shaft, at the same level, the vein also is well charged with copper.

Mayflower-Old Colony has met what is thought to be the Mayflower lode in the west crosscut at the 1,450 level. It carries some copper, and opening work here will continue in an effort to establish the strike. If the boundaries of the fault can be thus determined by this means, further development of the property will be attended with less uncertainty.

Seneca is making good headway in repairing No. 2 shaft, Gratiot, the shaft having been stripped to the thirteenth or bottom level, ready for the laying of a concrete skipway. With the completion of this work, sinking will be resumed. The old hoist will be used temporarily, but the new power and hoisting plant will be ready, it is expected, to go into operation by midsummer.

Ahmeek continues to take mass copper from the fissure vein in No. 2 shaft, the best showing in this vein being in the ninteenth level drift, west, where a fourteen-ton mass recently was cut from the main deposit. Ahmeek mass, it is estimated, adds fully 20 per cent to the production of the mine.

There is no change in Calumet & Hecla's operatione. Repairs to the Red Jacket shaft probably will take the greater part of the summer, and in the meantime No. 5 shaft will handle the tonnage ordinarily hoisted through the Red Jacket. Eventually, when the haulageway at the eighty-first level is completed, this will be the only hoisting shaft, and changes are being made with that end in view.

Gogebic Range

Freight Reduction Less Than Expected —Ottawa to Resume Mining

Ironwood—Pickands, Mather & Co. has started shipping a moderate amount of ore from the Plymouth pit at Wakefield.

Probably with the announcement of freight reductions effective July 1, the mining companies will make plans to begin heavy shipping on that date. The reduction in rates on ore is not as much as the mines had expected. Ore rates were formerly set to include the cost of switching and of spotting cars for steam shovels. When the Government took over the railroads it raised the rates in the same proportion as on other freight and in addition charged high rates for switching and spotting. On many roads in the mining country the ore traffic was made to "carry" all other traffic. It is this situation from which the mining com-

panies have sought relief. Some of the larger mine operators own their own railroads and are not much interested in ore rates, so that the fight for lower rates has been left to the smaller companies.

Two shifts are working at the Ottawa mine, and regular mining will be resumed as soon as possible. During the depression nothing but development work was done.

Marquette Range

Isabella Mine to Put On Full Crew—Valuation of Marquette County Mines Less

BY WILLIAM H. NEWETT

Palmer—The Steel & Tube Co. of America has issued orders to put on a full crew at the Isabella mine. Development work and a little mining were being done. A diamond drill has been placed at work on surface. The Richmond pit of the Richmond Iron Co. has started work and is shipping. This property is worked only during the period of navigation.

Negaunee—The Cleveland-Cliffs Iron Co. is again mining ore at the South Jackson pit. Few shipments are being made from any of the mines in the district, and most of the stockpiles are large.

Ishpeming—The State Tax Commission has placed a valuation of $35,000,000 on the iron ore mines of Marquette County for this year. This is a reduction of $300,000 from last year's figures.

Menominee Range

Bengal Mine to Resume Work—Two New Furnaces This Year

Iron River—Orders have been given by Pickands, Mather & Co. to resume operations at the Bengal mine, idle for two years. About 200 men will be employed. Ore hoisted will be shipped direct to the docks. The tax commission has granted a reduction in valuation of 10 per cent to idle mines and 5 per cent to active in the Iron River field.

Quinnesec—A considerable tonnage of low-grade iron ore has been developed by diamond drilling on the McKenna lands, and this will be mined and melted in the new blast furnace to be erected here. Another blast furnace is to be built at Iron Mountain to take ores from the West Chapin mines. It is expected that both will be built this year.

MINNESOTA

Mesabi Range

Oliver Company Starts Mining at Hull-Rust Pit

Hibbing—Ore operations at the Hull-Rust open pit, operated by the Oliver Iron Mining Co., have begun on a small scale.

The Rogers Brown Iron Mining Co. has resumed sinking on one shift.

Ely—The Zenith mine, operated by the Zenith Iron Mining Co., has begun shipping. The total hoist is being shipped daily.

JOPLIN-MIAMI DISTRICT

Hearing on Indian Lands Held at Miami

BY P. R. COLDREN

Joplin—A special hearing was begun at Miami, Okla., on May 26, before the special commission sent by the Indian Department to determine the value of Indian zinc and lead lands in Ottawa County, Okla.

It is expected that this hearing will be the final one before a report is made by the commission. It is being conducted at the Hotel Miami, and the important feature of the first day of the hearing was the announcement by W. W. Hastings and Horace B. Durant, attorneys for the Indians, that they considered 15 per cent a fair royalty for the lands.

This is at least 5 per cent higher than the ore producers feel the royalty ought to be, and some believe it should be no higher than 7½ per cent. They point out, too, that a higher royalty than 10 per cent will probably work to keep down operation of many mines and thus deprive the Indian land owners of money that they ordinarily would get.

The hearing is being held before J. E. Dawson, special supervisor from the U. S. Bureau of Mines, and O. K. Chandler, Quapaw Indian agent at Miami.

It is understood the investigation that has been conducted by the special commission is practically completed.

Zinc-ore producers are complaining of a shortage of shovelers in the district, a condition brought about largely by the fact that many of the men who who ordinarily work at shoveling have gone with their families to the strawberry fields in and near Joplin.

NEW YORK

Northern Ore Co. to Increase Output 50 Per Cent

Edwards.—The Northern Ore Co. is operating at maximum capacity and is planning to increase its production 50 per cent as fast as machinery and men can be secured. Effective May 1 the wage scale was advanced approximately 15 per cent. The company is employing practically all applicants. It has purchased electric haulage equipment and will electrify the underground haulage system. New equipment is to be installed in the mill to increase capacity. W. R. Wade is manager.

GEORGIA

Development of Bauxite Lands Proposed

F. C. Dunn, of 12 Bridge St., Hackensack, N. J., has taken an option on about 2,000 acres of clay land in Georgia, including deposits of bauxite, fuller's earth, and kaolin. The bauxite deposit is said to cover an area of about 500 acres and to represent a large tonnage. It is reported that a company will be organized to take over this land and install sufficient machinery to mine the bauxite. A three-and-a-half-mile railway spur will be needed.

ALABAMA

Furnace Activity Increasing—Interest Aroused in Raw Material Sources of State

BY GEORGE HUNTINGTON CLARK

Birmingham—The steady increase in iron making in Alabama shows no sign as yet of having reached a stopping point. To its two furnaces already active, one at Sheffield and the other at North Birmingham, the Sloss-Sheffield Steel & Iron Co. has added another at North Birmingham. Also it is announced that one City furnace and the Philadelphia furnace of the company will be making iron the first week in June, this bringing production to normal.

After two years of idleness, the Woodstock Operating Corporation, of Alabama, which controls the La Follette blast furnace situated at La Follette, Tenn., and the Woodstock blast furnace properties at Anniston, Ala., is preparing to resume operations at La Follette. The coal mines at La Follette are already in active operation. The Talladega furnace of the Bird Coal & Iron Co., which was rebuilt, will be started again, as soon as possible, together with the company's own coal mines and coke plant, red and brown ore mines, and limestone quarries.

Owing to the success of new methods for extracting aluminum from substances hitherto considered as not of commercial value, much interest has been aroused in this class of raw materials which are known to exist in substantial amounts in Alabama near available power sources.

To assist development of raw materials, the Alabama Geological Survey has established a substation as Birmingham. Here will be assembled exhibits of every class of raw material found in the state, together with all information obtainable.

ILLINOIS

Hillside Fluorspar Mines Completes New Plant

Rosiclaire.—The Hillside Fluorspar Mines has completed its new plant. Its new mine is now opened by a shaft and on three levels, the lowest being at 350 ft. The mine and mill are equipped electrically throughout. Concrete storage bins are used and are drained and covered to insure dry spar, which is loaded directly into Illinois Central cars at Roseview by belt conveyors. The mine on the original Rosiclaire vein is producing gravel and lump fluorspar.

VIRGINIA

Lyndhurst.—The Mount Tory Furnace tract consisting of more than 8,000 acres, including the Mount Tory iron and manganese mines, has been purchased by the Mount Tory Products Co. The company plans to erect a blast furnace and add mining equipment. Bonds will be issued to finance the improvements.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
25	13.625	30.25	31.125	5.50@5.625	5.425	5.20
26	13.625	30.25	31.125	5.50@5.625	5.45@5.50	5.225@5.25
27	13.625	30.25	31.25	5.50@5.65	5.45@5.50	5.25
29	13.625	30.50	31.50	5.50@5.75	5.50	5.25
30	.....	.....	.....	.....	.....	....
31	13.625	30.75	31.75	5.65@5.75	5.50	5.25@5.30

*These prices correspond to the following quotation for copper delivered: 13.875c. for the week.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
25	62⅜	62¾	68½	151	152½	24⅞	23⅜	27⅝	27½
26	62⅜	62¾	68½	150⅜	151¾	25	23⅜	27⅞	27¾
27	...	...	...	....	....	...	...	...	...
29	62⅜	62¾	68½	151	152¼	25	23½	28⅛	27⅞
30	62⅜	63	68½	152¼	153½	25⅛	23⅝	28⅛	27⅞
31	62¾	63⅛	68½	152⅜	153¼	25¼	23¾	28⅛	27⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
25	444½	99⅜	72¼	36⅝	29	444½	99⅝	71⅞	36⅜
26	444½	99⅜	72¼	36⅝	30	....	...	...	36½
27	444⅝	99⅜	71½	36¼	31	444⅝	99⅝	72¼	36½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, May 31, 1922

The metal markets have been quiet, owing to the Memorial Day holiday yesterday, especially as it was at the end of the month. Prices have in general held their own or advanced moderately. The coal strike still appears far from settlement, but no fuel scarcity is yet apparent at most plants.

The average prices for May published in another column reflect the improvement in metal prices which has taken place in the last two or three months. The figure for copper is one-half cent above the March and April average. Copper has shown a decidedly advancing tendency since the first of April. The lead average of 5.4c. compares with 4.7c. in March and 5.1c. in April. The advance in zinc has been regular and long continued, the upward movement dating from February. In that month the average was 4.5c., increasing by 0.2c. each following month. Zinc is still below the price of lead, however, an unusual condition for normal times. Tin has not fluctuated widely, but has been successively stronger the last two months. The advance in silver began on the first of March, the average for that month being 64.4c., and for April, 66.6c. Quicksilver and antimony also are advancing. Platinum has held exceptionally steady for four months.

Average Metal Prices for May

Copper	
New York Electrolytic	13.111
London Standard	61.092
London Electrolytic	66.554
Lead:	
New York	5.420
St. Louis	5.281
London	24.462
Silver:	
New York, foreign	71.154
New York, domestic	99.625
London	36.023
Sterling Exchange	444.106
Zinc:	
St. Louis	5.110
London	27.304
Tin:	
99 per cent	30.149
Straits	30.971
London	150.163
Antimony	5.467
Quicksilver	54 885
Platinum	85.529

Copper

Sales have not been of large volume, and the advance in price has not been continued. On Thursday and Friday, some effort was made to obtain 14c. delivered, but this price was, in general, realized only on carload lots, or where delivery charges were higher than normal. Practically all producers were quoting and selling at 13.875c. delivered, though it was possible to shade this price by 5 or 10 points on Monday and today in transactions where consumers' plants are so situated that freight rates are not more than 10c. or 15c. per hundred pounds. Copper for spot and June delivery was in only slight demand, most of the business being for July and August, with an occasional order for September. Near-by deliveries are bringing the same prices as are asked for later deliveries, though only one or two producers have any metal available for prompt shipment.

European prices ranged from 13⅞ to 14⅛c. c.i.f. on business of approximately normal volume.

Lead

The official contract price of the American Smelting & Refining Co. was advanced from 5.50 to 5.65c. per lb., New York, on Monday, May 29.

Though somewhat affected by the higher prices and the holiday, lead sales have continued in large volume, with some good-sized orders in the market. The demand has been good recently for corroding grades, which are commanding 10 points' premium. After Thursday, there was practically no lead available for less than 5⅝c. in the open market in New York, and prompt supplies even at this price were decidedly

scarce, many producers having sold out for May and the greater part of June. Today the usual price is 5.75c., with occasional quotations of prompt lead at 5.85c. The St. Louis market has advanced to a less degree, 5.50c. being generally realized on Monday and today. In that district there is now a pronounced effort to avoid a runaway market, and a lot of lead will probably be sold before the price goes much higher. An unhealthy reaction is feared by some producers, though fundamental conditions continue excellent, and 6c. lead is not unexpected. The present firm market throughout the world is, of course, due to curtailed production in Spain and Australia, but production in those countries will doubtless gradually increase when conditions become more normal.

Zinc

The market has not been an active one, but prices show a slight advance. All weakly held lots have disappeared from the market, and stocks are now so low that producers are not anxious to sell beyond current production. Were the coal strike settled, the demand for zinc would be likely to improve rapidly, with a sharp advance in prices. As it is, there seems no reason why the gradual advance of the last three months should not be continued. High-grade has advanced to 6¼c., with freight allowed, after continuing at 6c. for many weeks. Premiums for forward deliveries vary from 2½ to 5 points for each month beyond June. New York prices are 35 points above the St. Louis quotations.

Tin

Spot supplies of both 99 and Straits tin are rather scarce, but inquiry is not insistent. Prices continue substantially unchanged, nor is any disturbing factor now apparent. Tin for forward delivery has been available during the last three or four days at from ⅛ to ¼c. discount from the prices asked for spot.

Arrivals of tin, in long tons: May 23d, Straits, 75; 24th, Straits, 75; 25th, China, 15; 26th, Straits, 5; Liverpool, 50; 29th, London, 25; Batavia, 200.

Gold

Gold in London: May 25th, 93s. 5d.; 26th, 93s. 5d.; 29th, 93s. 3d.; 30th, 92s. 9d.; 31st, 92s. 9d.

Foreign Exchange

Foreign exchanges were featureless for the week. Today, francs were 9.125c.; lire, 5.235c.; marks, 0.3675c.; and Canadian dollars, 99.03c.

Silver

The weakness which developed last week continued until the 27th. On that date prices steadied and have advanced slightly since. The market closes quiet, but appears firm in tone, with a moderate inquiry from China.

Mexican Dollars—May 25th, 55¼; 26th, 55¼; 27th, 54⅝; 29th, 55; 31st, 55¼.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.25@18.25c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5.40@5.50c. W.C.C., 6@6½c. Cookson's "C" grade, spot, 8.75c. Chinese needle antimony, lump, nominal, 3.5@4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.15@$1.20 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2 per lb. in bbls.

Iridium—Nominal, $150@$170 per oz.

Magnesium—Ingots, 99 per cent, $1.10 per lb.

[1]**Molybdenum Metal**—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Monel Metal—Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne, N. J.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 29@32c. per lb.

Osmium—$70 per troy oz. Nominal, $70, Los Angeles, Cal.

Palladium—$55 per oz.

Platinum—$85@$87.50 per oz.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $54.70. Firm.

[1]**Rhodium**—$100@$115 per troy oz.

[1]**Selenium** — Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $18@$20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Basis 48 per cent Cr_2O_3, 40@45c. per unit, c.i.f. North Atlantic ports. Limited demand for 40@44 per cent Cr_2O_3 at $20 per net ton, f.o.b. Oregon main-line points.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore — F.o.b. Port Henry N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore—26@27c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump. Nominal.

Molybdenum Ore—50c. per lb. of MoS_2, for 85 per cent MoS_2 concentrates. Demand is good.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots. Hand-sorted ore, 70 per cent combined columbite-tantalite, active at 40c. per lb., South Dakota.

[1]**Titanium Ores**—Ilmenite 52 per cent TiO_2, 1¼@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore — Chinese ore, $3.50@$3.75 per unit of WO_3. Colorado producers remain closed down on account of lack of profitable market.

Uranium Ore (Carnotite) — Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively. Market reported dead in Colorado.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon — Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

Zinc and Lead Ore Markets

Joplin, Mo., May 27—Zinc blende, per ton, high, $32.30; basis 60 per cent zinc, premium, $31.50; Prime Western, $29@$32.50; fines and slimes $28@$27; average settling price, all grades of blende, $29.69. Calamine, basis 40 per cent zinc, $15.

Lead, high, $73.40; basis 80 per cent lead, $70; average settling price, all lead ores, $71.11 per ton.

Shipments for the week: Blende, 11,570; calamine, 32; lead, 1,888 tons. Value, all ores the week, $448,270.

Shipments for five months: Blende, 176,503; calamine, 458; lead, 39,195 tons. Value, all ores five months, $7,418,140.

In the purchase on $32.50 basis the blende was high in iron, and the higher basis was offered rather than reduce the system of penalizing for iron content.

Lead continues in strong demand, though two concerns have dropped from the market. The remaining three in the market keep competition keen enough on the ruling basis price.

Platteville, Wis., May 27—Blende, basis 60 per cent zinc, $31 per ton. Lead ore, basis 80 per cent lead, $73.50 per ton. Shipments for the week: Blende, 407 tons; lead ore, 70 tons. Shipments for the year: Blende 6,407 tons; lead ore, 937 tons. Shipped during the week to separating plants, 663 tons blende.

Non-Metallic Minerals

Asbestos—No. 1 crude, $900@$1,200 per ton, f.o.b. Quebec mines; No. 2, $450@$600; long spinning fibre, $350@$500; spinning fibre, $250@$350; shingle stock, $90@$125; paper stock, $35@$55; cement stock, $22@$28; short fibre, $15. Market is decidedly improved on all short fibres. Movement of crudes and spinning fibres is slow.

Barytes—Crude, $9 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $16@$21, f.o.b. Southern mills. Foreign barytes, c.i.f. New York, $7.80@$8.25 per ton crude.

[1]Furnished by Foote Mineral Co., Philadelphia, Pa.

Market improving for chemical, rubber, and paint uses.

Bauxite — American, crushed and dried, $6@$9 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $22@$25 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $5@$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

Borax—Granulated, crystals or powdered, in bags, carloads, 5¼c. per lb.; in bbls., 5½c. Boric acid, 11c. Dull.

Chalk—English, extra light, 5c. Domestic light, 4½@4¾c.; heavy, 3½@3¾c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, $6@$8; washed, $8@$9; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $14@$20, f.o.b. American ports; powdered, $35@$45, f.o.b., New York.

Emery—Turkish emery, 6c. per lb. American, 4c. Inferior grades, 3½c., f.o.b. from New England points. Market good and improving.

Feldspar—No. 1 pottery grade, crude, unground, $6.40 per ton, f.o.b. mines; demand good. No. 1 Canadian, $22 per short ton, Ohio mills; demand poor. In North Carolina, No. 1, 140 mesh, bulk, $17.50 per ton, f.o.b. factory; No. 2, 90 to 100 mesh, $9.50. Market fair.

Fluorspar — Lump, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20 per ton; gravel, $17.50. Acid, lump, $40@$50. No. 1 ground, $50@$55, f.o.b. Illinois and Kentucky mines. Lump, $12.50@$13.50; ground, 95@96 per cent, $25@$26, f.o.b. New Mexico. Fairly active.

Fuller's Earth—16 to 30 mesh, $19 per ton; 30 to 60 mesh, $17.50; 60 to 100 mesh, $14; 100 mesh and finer, $14; f.o.b. Florida mines. Exceptionally little demand in East, but some Texas mills running full capacity.

Graphite—Ceylon lump, first quality, 6@7c.; chip, 4½@5½c.; dust, 3½@4c. per lb.; No. 1 flake, 7@8c.; amorphous crude, domestic, $15@$25 per ton (f.o.b. cars); foreign, $55@$65 per ton, depending upon quality. Unless otherwise noted, all f.o.b. New York. Practically no market at any price except for best grades.

Gypsum — Crushed rock, $3@$4.50 per ton, depending upon shipping point. Ground, $4, f.o.b. shipping point.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¼ in. and larger, $1.10@$1.25 per net ton. Agricultural limestone, $2.50@$3 net ton, f.o.b. eastern shipping points.

Magnesite—Crude, $8@$12 per ton. High-grade caustic calcined, lump form, $30@$45 per ton. Plastic calcined, $45@$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $28 per ton, f.o.b. Baltimore. (Magnesite brick — See Refractories.)

Mica — India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, $1.25; No. 4, $2.25; No. 3, $2.90; No. 2, $4; No. 1, $5.20. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3; No. 3, $4.75; No. 2, $6; No. 1, $7.50; A1, $9; ground, wallpaper grade, $90@$200 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York. Water-ground mica, 100 and 160 mesh, 6½c. per lb., f.o.b. Virginia points.

[1]**Monazite**—Minimum 6 per cent ThO_2, 8@10c. per lb.

Phosphate Rock—Per long ton, Florida ports, pebble grade: 77 per cent tricalcium phosphate, $8.50 ($9.50 for hard rock); 75 per cent, $7; 75@74 per cent, $6.50; 70 per cent, $4.75; 68@66 per cent, $4.40.

Pumice Stone—Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaports; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica—Glass sand, $0.75@$1.75 per ton; sand-blast material, $2@$4, f.o.b. Indiana and Illinois points.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—Through 200 mesh, $18 per ton, f.o.b. California mills; $13.50, New York mills. Through No. 25 Swiss silk, $25, California. Tendency is for a finer grind, some paint makers desiring 300 mesh.

Mineral Products

Arsenic Oxide—7c. per lb.

Copper Sulphate—Nominally 6c. per lb. Extremely scarce.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate—$2.70@$2.80 per 100 lb. ex-vessel Atlantic ports.

Sodium Sulphate—$20@$25 per ton, New York.

Ferro-Alloys

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

Ferromanganese—Domestic, 78 to 82 per cent, $67@$69, f.o.b. furnace; English, $67.50; German, $66, both c.i.f. Atlantic seaports. Spiegeleisen, 19 to 21 per cent, scarce at $36 per gross ton, f.o.b. furnace; 16 to 19 per cent, $35.

Ferromolybdenum—$2@$2.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $56@$58; 75 per cent, $115@$120.

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

[1]Foote Mineral Co., Philadelphia, Pa.

Ferrotungsten — Domestic, 70 to 80 per cent W, 45@50c. per lb. of contained W, f.o.b. works.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.75@$4 per lb. of V contained. Market active.

Metal Products

Copper Sheets — New York base, 20.25c. per lb.; wire, 15.25c.

Lead Sheets—Full lead sheets, 8.75c.; cut lead sheets, 9c. in quantity, mill lots.

Nickel Silver—26.75c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.50c.; rods, 14.50c.

Zinc Sheets—$7.50 per 100 lb. less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $130 per 1,000; 76 per cent, Suprafrax, $200 per 1,000; f.o.b. works, St. Louis and Pittsburgh.

Chrome Brick—$40@$42 per net ton.

Chrome Cement—$23 per net ton, Baltimore.

Firebrick—First quality, 9-in. shapes, $28@$35 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in., straights, $53 per net ton, f.o.b. works.

Magnesite Cement—$33 per net ton, Baltimore.

Silica Brick—9-in., per 1,000, $30@$35 in carload lots, f.o.b. shipping points.

[1]**Zirkite**—Powdered, $50@$60 per ton; brick, $100 per ton.

The Iron Trade

Pittsburgh, May 29, 1922

The steel market has grown even quieter in the last week. The price situation shows the market to be in strong position. Bars, shapes and plates are at 1.60c. as minimum, and some sales run up to 1.80c., representing a delivery premium of $4 a ton. Sheets are firm at the 3.15c. basis, with some selling into third quarter at this figure, and some independent mills quoting advanced prices. At this writing the American Sheet & Tin Plate Co. has not opened order books for third quarter. It is established that tin plate will not be advanced from $4.75.

Steel ingot production is at a rate of about 38,000,000 tons a year. The Carnegie Steel Co. is operating thirty-five blast furnaces, against thirty-four on April 1.

Pig Iron—A few small sales of bessemer have established a price of $25, Valley, against the former nominal quotation of $26. Basic remains quotable at $25 and foundry at $24, Valley.

Connellsville Coke — Buying for a furnace at Monessen about to resume has helped to advance the market to $7 on furnace coke, and foundry coke, with light demand, is up to $7 in sympathy. Connellsville coal is easier, at $3@$3.25 for steam grade.

COMPANY REPORTS

Chino Copper Co.

The statement of operations of the Chino Copper Co. for the year ended Dec. 31, 1921, is as follows:

Operating revenue		
Copper produced, 9,137,282 lb. @ 13.026c.	$1,190,203	
Gold produced, 214.4 oz. @ $20.00	4,288	
		$1,194,492
Operating expenses		
Mining, including stripping expenses	$385,686	
Ore delivery, mine to mill	54,694	
Milling	497,096	
Treatment, freight and refining	409,105	
Selling expense	30,545	
		1,377,128
Net loss from operations		$182,635
Net miscellaneous income		54,871
Net loss		$127,764
Charges against income		
Depreciation	474,304	
Shutdown expense	610,348	
Loss on copper sold during shut-down period	101,787	
		1,186,440
Total loss to surplus account		$1,314,204

CURRENT ASSETS

	Dec. 31, 1921	Dec. 31, 1920
Copper on hand and in transit	$1,365,482	$4,727,844
Ore at mill	10,768	23,255
Ore and concentrate storage	.....	88,458
Leaching ore	70,791	70,791
Accounts receivable and prepaid insurance	181,652	180,100
Material and supplies on hand	1,416,342	1,744,854
Cash	699,603	385,785
Cash due copper deliveries	354,555	148,614
Total current assets	$4,099,196	$7,369,705

CURRENT LIABILITIES

Current accounts	$39,304	$232,529
Accrued taxes and insurance	1,547,387	1,565,773
Treatment, refining and delivery charges not yet due	28,937	315,928
Bills payable	750,000	1,750,064
Total current liabilities	$2,365,628	$3,864,296
Surplus quick assets	1,733,568	3,505,409

SURPLUS FROM OPERATIONS

Balance, Dec. 31, 1920	$13,889,908
Loss for year (exclusive of any deduction for depletion)	1,314,204
Balance, Dec. 31, 1921	$12,575,703

Because of industrial conditions, the mine at Santa Rita, N. M., was closed down on April 8, and the mill at Hurley on April 12. Operating at 30 per cent of capacity, the net cost was 14.5c per lb. of copper, excluding Federal and excess-profits taxes and depreciation, but including income from precious metals and miscellaneous sources. A total of 361,660 tons was treated, averaging 1.70 per cent copper. Reserves are 105,385,000 tons, of an average grade of 1.58 per cent copper.

North Star Mines Co.

A report of operations of the North Star Mines Co. for 1921 states that during the year the gross production of the mine was $922,769.58. The expenses for current operation amounted to $632,077.59 and for development to $109,148.57, or a total outlay for operation and development of $741,226.16, leaving an operating profit of $181,543.42. At the Champion mines, the sum of $14,109.55 was received as net proceeds of the sale of old materials salvaged, of which $5,000 was credited to improvement account and $9,109.55 to operating account.

The final cleaning up of the Champion mine resulted in a production of $704.25, while sundry expenses amounted to $6,625.17, so that there was a net credit to Champion operating account of $3,188.63. The total production of the company's mines was therefore $923,473.83, with total operating and development expenses of $738,741.78, leaving an operating profit of $184,732.05. Interest and dividends on invested funds amounted to $42,366.64, increasing the total net earnings of the year, before deduction of allowance for depletion and depreciation, to $227,098.69, or, including profit of $2,250 realized from sale of investments, $229,348.69.

The amount allowed for depletion and depreciation at the North Star mine, on the same basis as in previous years, was $175,340.19. At the Champion, the value of the mine having already been written down to the nominal sum of $1,000, no further allowance was made for depletion. The remaining book value of the improvements, after credit of $5,000 received for old materials salvaged, as above stated, and after deducting $9,474.35 as the depreciation allowance for 1921, calculated at the rate established several years ago, was $33,204.15. As operations at the Champion mine have now been finally abandoned, the improvements have no value beyond such small amount as may still be obtained from the sale of materials remaining on hand, and consequently a further allowance of $20,000 was made to represent the loss on the improvements, reducing their book value as at the end of 1921 to $13,204.14. The aggregate amount allowed for depletion and depreciation in 1921 was therefore $204,814.54, reducing the net surplus on the year's operations to $24,534.15. This sum was applied in reduction of the deficiency in surplus account, which at the beginning of the year amounted to $373,166.74, leaving a deficit at the end of 1921 of $348,632.59, as shown in the accompanying balance sheet. One dividend of 2 per cent, amounting to $50,000, was declared as a distribution of capital assets and paid in March.

Deficit Dec. 31, 1920, was $373,166.74. Production for 1921 was $923,473.83, to which interests and dividends was added, giving a total of $968,090.47. Operating and development expenses were $738,741.78; depletion amounted to $152,000, and depreciation was $52,814.54; a total of $943,556.32. Profit was $24,534.15 and the deficit balance on Dec. 31, 1921, $348,632.59.

Tharsis Sulphur & Copper Co., Ltd.

The operations of the Tharsis Sulphur & Copper Co. at its works in Spain were suspended during the greater part of 1921, owing to the small demand for pyrites. Operations at the metal works in England were suspended by the coal miners' strike, and are only gradually being resumed as demand arises for purple iron ore, their chief product.

The profit-and-loss account on Dec. 31, 1921, was as follows:

DEBIT

Income and corporation profits taxes, directors' and auditors' fees		£58,815
Charges account, including management, salaries, law and laboratory expenses		32,848
Amount written off property in Spain		4,587
Net profit for 1921	£45,945	
Net profit for 1920	27,156	
Balance		73,101
		£169,350

CREDIT

Balance carried forward	£158,406	
Less dividend, May 10, 1921	131,250	
		27,156
Interest account		12,668
Profit for 1921		129,526
		£169,350

There are 625,000 shares of £2 each, fully paid. Property and assets total £2,052,560.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1921	1922	1921	1922	1921	1922
January	65.930	65.450	39.985	35.035	372.650	421.750
February	59.233	65.290	34.745	33.891	385.932	435.511
March	56.023	64.440	32.479	33.269	389.806	436.912
April	53.337	66.575	34.250	34.080	391.784	440.715
May	53.810	71.154	34.165	36.023	396.580	444.106
June	58.510	.....	34.971	.....	377.236	.....
July	60.260	.....	37.481	.....	362.565	.....
August	61.597	.....	38.096	.....	364.505	.....
September	66.160	.....	40.082	.....	371.725	.....
October	70.970	.....	41.442	.....	386.315	.....
November	68.234	.....	38.750	.....	396.315	.....
December	65.760	.....	35.645	.....	414.880	.....
Year	62.654	.....	36.841	.....	384.191	.....

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1921	1922	1921	1922	1921	1922
January	12.597	13.465	70.964	65.226	79.119	72.321
February	12.556	12.864	70.925	60.250	75.925	66.125
March	11.976	12.567	67.565	59.245	71.190	65.739
April	12.438	12.573	69.381	58.799	71.786	64.028
May	12.742	13.111	73.196	61.092	74.298	66.554
June	12.697	.....	71.852	.....	75.682	.....
July	12.170	.....	71.155	.....	75.286	.....
August	11.634	.....	68.614	.....	72.705	.....
September	11.948	.....	67.977	.....	72.295	.....
October	12.673	.....	67.327	.....	73.476	.....
November	13.035	.....	66.614	.....	74.386	.....
December	13.555	.....	66.706	.....	74.525	.....
Year	12.502	.....	69.356	.....	74.223	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London	
	1921	1922	1921	1922	1921	1922
January	4.821	4.700	4.747	4.388	23.387	23.667
February	4.373	4.700	4.228	4.396	20.650	20.681
March	4.084	4.720	4.000	4.421	18.911	21.266
April	4.356	5.115	4.272	4.946	20.589	22.993
May	4.952	5.420	4.784	5.281	23.399	24.462
June	4.485	.....	4.293	.....	22.563	.....
July	4.410	.....	4.260	.....	23.399	.....
August	4.382	.....	4.217	.....	23.489	.....
September	4.600	.....	4.392	.....	23.148	.....
October	4.690	.....	4.439	.....	23.679	.....
November	4.683	.....	4.356	.....	24.483	.....
December	4.700	.....	4.369	.....	25.322	.....
Year	4.545	.....	4.363	.....	22.752	.....

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1921	1922	1921	1922	1921	1922
January	31.470	31.480	36.000	32.100	190.464	163.065
February	28.534	29.835	32.142	30.767	166.250	149.850
March	27.296	28.426	28.806	29.171	156.024	143.152
April	28.990	29.810	30.404	30.605	163.905	149.840
May	31.431	30.149	32.500	30.971	177.411	150.163
June	28.514	.....	29.423	.....	167.506	.....
July	26.755	.....	27.655	.....	164.530	.....
August	25.662	.....	26.301	.....	155.318	.....
September	26.280	.....	26.680	.....	156.750	.....
October	27.278	.....	27.655	.....	156.380	.....
November	28.592	.....	28.935	.....	158.898	.....
December	32.106		32.486	.....	169.738	.....
Year	28.576	.....	29.916	.....	165.265	.....

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis		London	
	1921	1922	1921	1922
January	5.413	4.691	25.262	26.321
February	4.928	4.485	24.850	24.215
March	4.737	4.658	25.077	25.467
April	4.747	4.906	25.530	26.576
May	4.848	5.110	26.923	27.304
June	4.421	.....	26.750	.....
July	4.239	.....	26.262	.....
August	4.186	.....	25.068	.....
September	4.235	.....	25.256	.....
October	4.605	.....	26.315	.....
November	4.667	.....	25.949	.....
December	4.835	.....	26.900	.....
Year	4.655	.....	25.845	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)	
	New York		New York		New York	
	1921	1922	1921	1922	1921	1922
January	5.258	4.463	48.440	49.960	73.400	97.260
February	5.250	4.416	49.545	48.295	70.227	89.545
March	5.282	4.319	46.796	50.204	72.463	87.500
April	5.137	4.980	45.423	52.280	73.404	87.500
May	5.250	5.467	47.000	54.885	73.740	85.529
June	5.087	.....	46.846	.....	74.942	.....
July	4.735	.....	44.950	.....	70.440	.....
August	4.597	.....	45.028	.....	73.222	.....
September	4.564	.....	42.660	.....	75.960	.....
October	5.085	.....	39.840	.....	81.800	.....
November	4.734	.....	39.804	.....	82.609	.....
December	4.500	.....	49.212	.....	78.192	.....
Year	4.957	.....	45.462	.....	75.033	.....

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1921	1922	1921	1922	1921	1922
January	33.96	21.55	31.96	20.15	33.88	21.34
February	28.96	21.46	26.96	19.71	30.25	20.88
March	28.16	21.35	26.46	19.96	27.85	20.83
April	26.96	22.50	24.46	21.26	26.77	22.70
May	26.21	.....	23.84	.....	25.56	.....
June	24.96	.....	22.66	.....	24.38	.....
July	22.84	.....	20.76	.....	22.36	.....
August	21.96	.....	20.29	.....	21.53	.....
September	21.96	.....	21.21	.....	22.82	.....
October	21.96	.....	20.96	.....	22.96	.....
November	21.96	.....	20.96	.....	22.74	.....
December	21.96	.....	20.65	.....	21.96	.....
Year	25.15	.....	23.43	.....	5.26	.....

In dollars per long ton.

Monthly Crude Copper Production

	1922			
	January	February	March	April
Alaska shipments	6,909,383	4,193,357	4,899,827	5,892,923
Anaconda	(a)	9,503,000	13,100,000	14,508,955
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	2,462,000	3,167,070	3,756,000
Calumet & Hecla	(a)	(a)	(a)	(c)
Other Lake Superior	6,000,000	6,000,000	6,000,000	(c)
Chino	(a)	(a)	(a)	(c)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
East Butte	(b) 750,000	(a)	(a)	(c)
Inspiration	(a)	2,485,000	4,965,000	(c)
Magma	(a)	(a)	(a)	(a)
Miami	5,348,000	4,918,000	5,242,000	(c)
Nevada Cons.	(a)	(a)	(a)	(c)
New Cornelia	1,602,909	1,459,063	1,606,977	1,496,242
Old Dominion	(a)	(a)	(a)	1,164,000
Phelps Dodge	(a)	4,091,000	5,540,000	5,881,000
Ray	(a)	(a)	(a)	(c)
Shattuck Arizona	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	646,110	2,014,886	3,517,902
Utah Copper	(a)	(a)	(a)	(c)
Others, estimated	11,400,000	10,200,000	9,170,000	.....
Total United States	32,010,292	45,957,530	55,705,760	.....
Imports: Ore and concentrates, matte	7,136,976	5,081,497	3,974,424	10,816,696
Imports of black and blister, unrefined	5,178,068	18,081,802	17,205,149	19,015,875
Imports of refined and old	565,439	5,024,806	17,943,178	9,766,230
Grand total	44,890,775	74,145,635	94,828,511	.....
Backus & Johnston	1,118,000	990,000	910,000	888,000
Boleo	1,102,080	954,765	1,117,384	838,000
Cananea	(a)	(a)	(a)	(a)
Cerro de Pasco	4,726,000	4,868,000	4,702,000	4,830,000
Chile	4,000,000	4,000,000	4,000,000	(c)
Cons. M. & S. of Canada	97,985	26,000	124,000	464,000
Falcon Mines	582,000	566,800	550,682	596,570
Furukawa	2,357,258	2,702,636	3,211,868	.....
Granby Cons.	1,974,162	955,038	1,922,462	(c)
Hampden Cloncurry	(a)	(a)	(a)	.....
Katanga	6,772,600	5,785,920	6,740,000	7,285,000
Mount Morgan	(a)	(a)	(a)	(a)
Mount Lyell	1,152,000	1,152,000	.....	.....
Phelps Dodge Mexican	(a)	318,000	397,000	379,000
Sumitomo	1,439,488	3,089 353	1,806,888	.....
Wallaroo & Moonta	122,575	828,821	489,599	(a)

(a) No copper produced during this month. (b) Estimated. (c) Not available.

Comparative Annual Copper Production

	1919	1920	1921	1922
January	135,733,511	121,903,744	90,596,597	32,010,292
February	111,649,512	117,540,000	86,682,941	45,957,530
March	102,040,460	120,309,316	91 046,345	55,705,760
April	98,808,998	116,078,871	46,946,523	.....
May	92,652,975	114,964,207	25,310,511	.....
June	95,856,570	116,107,856	24,623,693	.....
July	100,369,247	109,729,610	22,033,739	.....
August	107,994,040	112,460,254	23,248,398	.....
September	108,703,075	104,919,562	23,855,316	.....
October	115,143,143	105,231,571	23,231,572	.....
November	117,289,735	106,700,178	28,341,442	.....
December	102,997,633	95,709,009	29,629,137	.....

MINING STOCKS

Week Ended May 27, 1922

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	64½	64	64	Sept. '20, Q	$0.50
Alaska-Br. Col. new.	N. Y. Curb	5¼	4⅞	5⅛	.....	....
Allouez	Boston	28	28	28	Mar. '19	1.00
Anaconda	New York	56	54⅝	55⅛	Nov. '20, Q	1.00
Arcadian Consol.	Boston	4½	3⅜	4⅜	.....	....
Ariz. Com'l	Boston	10	9⅜	10	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*23	*20	*22	.....	....
Bingham Mines	Boston	15⅞	15	15⅝	Sept. '19, Q	0.25
Calumet & Arizona	Boston	62¾	61	62	Mar. '22, Q	0.50
Calumet & Hecla	Boston	290	285	290	June '20, Q	5.00
Canada Copper	N. Y. Curb	*47	*43	*43	.....	....
Centennial	Boston	11½	11	11½	Dec. '18, SA	1.00
Cerro de Pasco	New York	40⅛	39⅜	40⅛	Mar. '21, Q	0.50
Chile Copper	New York	22⅜	22¼	22⅛	.....	....
Chino	New York	31⅛	30⅜	31⅛	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*29½	*27½	*29½	.....	....
Con. Arizona	N. Y. Curb	*5	*3	*4	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1⅛	1⅛	1 1/16	.....	....
Copper Range	Boston	45	43½	44½	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1⅜	1⅛	1⅜	.....	....
Davis-Daly	Boston	9	8½	9	Mar. '20, Q	0.25
East Butte	Boston	12	11½	12	Dec. '19, A	0.50
First National	Boston Curb	*85	*75	*85	Feb. '19, SA	0.15
Franklin	Boston	2⅜	2¼	2⅜	.....	....
Gadsden Copper	Boston Curb	1⅜	1⅛	1⅛	.....	....
Granby Consol.	New York	35	32½	34½	May '19, Q	1.25
Greene-Cananea	New York	33⅜	33	33	Nov. '20, Q	0.50
Hancock	Boston	3½	3½	3½	.....	....
Howe Sound	N. Y. Curb	3½	3¼	3⅜	Jan. '21, Q	0.05
Inspiration Consol.	New York	43½	42	4 1/16	Oct. '20, Q	1.00
Iron Cap	Boston Curb	8¼	8	8½	Sept. '20, K	0.25
Isle Royale	Boston	25	25	25	Sept. '19, SA	0.50
Kennecott	New York	38⅞	37⅞	38⅛	Dec. '20, Q	0.50
Keweenaw	Boston	2⅜	2⅛	3⅛	.....	....
Lake Copper	Boston	5⅛	4½	4⅜	.....	....
La Salle	Boston	2	1⅞	1⅞	.....	....
Magma Copper	N. Y. Curb	32	31¼	31⅝	Jan. '19, Q	0.50
Majestic	Boston Curb	*14	*9	*10	.....	....
Mason Valley	Boston	2⅛	2⅛	2⅛	.....	....
Mass. Consolidated	Boston	3⅜	2⅜	3⅛	Nov. '17, Q	1.00
Miami Copper	New York	30⅜	30	30⅛	May '22 Q	0.50
Michigan	Boston	3	2⅛	3	.....	....
Mohawk	Boston	65	61	65	Feb. '22, Q	1.00
Mother Lode Coa	N. Y. Curb	10⅛	9⅞	10⅛	.....	....
Nevada Consol.	New York	18⅜	18⅛	18⅛	Sept. '20, Q	0.25
New Cornelia	Boston	19⅞	19¼	19⅛	May '22, K	0.25
North Butte	Boston	14⅛	13	12⅛	Oct. '18, Q	0.25
North Lake	Boston	⅜	⅜	⅜	.....	....
Ohio Copper	N. Y. Curb	*10	*9	*10	.....	....
Old Dominion	Boston	26	25	25	Dec. '18, Q	1.00
Osceola	Boston	37	36	36	June '20, Q	0.50
Phelps Dodge	Open Mar.	†180	†170	...	Apr. '22, Q	1.00
Quincy	Boston	47½	45½	47	Mar. '20, Q	1.00
Ray Consolidated	New York	18⅛	17⅛	18	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	2⅛	1⅞	2	.....	....
St. Mary's Min. Ld.	Boston	47⅛	46	46⅛	Apr. '22, K	2.00
Seneca Copper	Boston	14⅛	14¼	14⅜	.....	....
Shannon	Boston	1 1/16	1	1	Nov. '17, Q	0.25
Shattuck Arizona	New York	11¼	10⅛	11	Jan. '20, Q	0.25
South Lake	Boston	1⅛	1⅛	1⅛	.....	....
Superior & Boston	Boston	1⅞	1⅝	1⅝	.....	....
Tenn. C. & C. cfs	New York	12⅛	12	12⅛	May '18, I	1.00
Tuolumne	Boston	*92	*80	*80	May '13,	0.10
United Verde Ex.	Boston Curb	31	29	29½	May '22, Q	0.25
Utah Consol.	Boston	3	2⅛	3	Sept. '18,	0.25
Utah Copper	New York	69	66⅛	69	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1⅛	1⅛	1⅛	Dec. '17,	0.30
Victoria	Boston	2⅛	2	2⅛	.....	....
Winona	Boston	1⅛	1⅛	1⅛	.....	....
Wolverine	Boston	15	14½	14⅝	.....	....
NICKEL-COPPER						
Internat. Nickel	New York	18⅛	17⅝	18	Mar. '19,	0.50
Internat. Nickel, pfd	New York	80	80	80	May. '22, Q	1.50
LEAD						
National Lead	New York	96⅛	93⅛	96⅛	Mar. '22, Q	1.50
National Lead, pfd	New York	111	109	109	Mar. '22, Q	1.75
St. Joseph Lead	New York	15⅞	15⅛	15⅛	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	1⅛	1¼	1⅛	.....	....
ZINC						
Am. Z. L. & S.	New York	20⅛	19	19⅛	May '20,	1.00
Am. Z. L. & S. pfd.	New York	48	47⅛	47⅛	Nov. '20, Q	1.50
Butte C. & Z.	New York	7⅞	7⅛	7⅛	June '18,	0.50
Butte & Superior	New York	33¼	31⅛	32	Sept. '20,	1.25
Callahan Zn-Ld.	New York	11⅛	9⅛	11⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	146	144	144⅛	May '22, Q	2.00
Yellow Pine	Los Angeles	....	....	*51½	Sept. '20, Q	0.03

Stock	Exch.	High	Low	Last		Last Div
GOLD						
Alaska Gold	New York	⅜	⅜	⅜	.....	....
Alaska Juneau	New York	1⅛	1⅛	1⅛	.....	....
Carson Hill	New York	†14	†12	14½	.....	....
Cresson Consol. G.	N. Y. Curb	2¼	2⅛	2⅛	Apr. '22, Q, X	$0.10
Dome Extension	Toronto	1	1	1	.....	....
Dome Mines	New York	29⅜	27⅛	29⅛	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*22	*20	*20	.....	....
Golden Cycle	Colo. Springs	*80	*76½	*78	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*8	*8	*8	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.65	9.55	9.65	May '22,	0.05
Homestake Mining	New York	71	70	70	May '22, M	0.25
Kirkland Lake	Toronto	*44½	*35	*35	.....	....
Lake Shore	Toronto	2.34	2.22	2.25	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	18.00	17.50	17.80	May '22, K	0.05
Porcupine Crown	Toronto	*29	*25	*26½	July '17,	0.03
Porcupine V. N. T.	Toronto	*32	*23¾	*27	.....	....
Portland	Colo. Springs	*30	*28	*28	Oct. '20, Q	0.01
Schumacher	Toronto	*64	*56	*63	.....	....
Silver Pick	N. Y. Curb	*16	*9	*9	.....	....
Teck Hughes	Toronto	*48½	*40	*48	.....	....
Tom Reed	Los Angeles	*71	*70	*71	Dec. '19,	0.02
United Eastern	N. Y. Curb	1⅛	1⅛	1⅛	Apr. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*9	*8	*8	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*8	*8	*8	.....	....
Wright-Hargreaves	Toronto	3.00	2.70	2.75	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1	*91	1	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅛	1⅛	1⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*33	*27½	*29	May '20, K	0.03
Coniagas	Toronto	1.25	1.20	1.20	May '21, Q	0.12½
Crown Reserve	Toronto	*19	*17	*19	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3¼	3⅛	3⅛	Apr. '22, Q	0.12½
La Rose	Toronto	*36	*32	*36	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*29½	*28	*28	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.05	95	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6¼	6¼	Apr. '22, Q, X	0.30
Ontario Silver	New York	8½	8	8	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	...	...	*12	Jan. '12,	0.10
Temiskaming	Toronto	*35	*30	*35	Jan. '20, K	0.04
Trethewey	Toronto	*4½	*3½	*4½	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*23	*19	*20	.....	....
Cash Boy	N. Y. Curb	*5	*5	*5	.....	....
Dolores Esperanza	N. Y. Curb	2½	2⅜	2½	.....	....
El Salvador	N. Y. Curb	*6	*5	*5	.....	....
Jim Butler	N. Y. Curb	*7	*7	*7	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*6	*5	*6	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*9	*7	*7	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅞	1 1/16	1 1/16	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*77	*75	*77	.....	....
Tonopah Extension	N. Y. Curb	1⅜	1⅛	1 1/16	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅛	1 1/16	1⅛	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1⅛	1	1⅛	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*10	*6	*10	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*95	*94	*94	Dec. '20,	0.15
Chief Consol.	Boston Curb	5⅛	4⅞	4⅞	May '22, Q	0.05
Consol. M. & S.	Montreal	23½	22	23½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.20	...	July '20, Q	0.10
Daly-West	Boston	†2½	†2	2	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*8½	*6	*8½	May '20, SA	0.03
Federal M. & S.	New York	16	14½	14½	Jan. '09,	1.50
Federal M. & S. pfd.	New York	52⅜	50⅛	50⅛	Mar. '22, Q	1.00
Florence Silver	Spokane	*23	*21⅛	*23	Apr. '19,	0.01½
Grand Central	Salt Lake	*61	*60	*61	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6½	6⅛	6⅛	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*22	*22	*22	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	†2.50	†2.20	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*31	*20	*29	June '21, I	0.02
Prince Consol.	Salt Lake	*7½	*5½	*6	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6¼	*5	*6½	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*12	*10	*11	.....	....
South Hecla	Salt Lake	†*60	†*35	..	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*21	*19	*21	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*10	*9	*9	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.45	2.45	2.45	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.05	2.02½	2.02½	Dec. '21, Q	0.05
Utah Apex	Boston	3⅛	3⅛	3⅛	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	51⅛	48⅛	48⅛	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	57	55	56	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	75⅛	75	75⅛	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	21⅛	20⅜	21⅛	Nov. '19, Q	1.00
Texas Gulf	New York	47	45⅛	47	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	66⅛	64⅛	65	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	99	98	98	Mar. '22 Q	1.75
Am. Sm. Sec. pf. A.	New York	93	93	93	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	44⅛	42⅛	44	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	47	46⅛	47	Apr. '22, Q	1.75

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

NEW MACHINERY AND INVENTIONS

A Center-Feed, Screen-Discharge Rod Mill

Four-Compartment Machine Has Probable Application in Table-Concentration and Amalgamation Plants

BY A. W. ALLEN

AN ESSENTIAL FEATURE of any efficient machine designed to crush ore should be the provision for a prompt discharge of all material that is ground sufficiently fine. In addition, repairs and renewals should involve no more than normal expense, and power consumption should not be prohibitive. The introduction of the trunnion-feed and trunnion-discharge ball mill, in place of the stamp mill or other machine, simplified operations to such an extent that the expense for extra power was considered as more than offset by the advantages accruing from continuity of operation and reduction in attention needed for operation, repairs, and renewals. Latterly, the cylindrical rod mill has displaced, to a considerable extent, the ball mill; this was due to more efficient operation and because of the texture of the product and its suitability for concentration purposes. A comparatively high power consumption is, however, still a feature of all cylindrical mills of standard type.

The original Krupp wet-crushing ball mill was remarkably efficient as a grinder of hard ores, because of the enormous available screening area around the periphery and the prompt discharge of all particles of ore able to pass the screen aperture. It failed of general acceptance because of initial cost and complication of design. However, I am inclined to think that, had it been credited with the advantage that a carefully graded product was delivered without the need for outside classification and return apparatus, the fundamental idea would have found greater favor among millmen and those manufacturing ball mills.

Several engineers have attempted to evolve a balanced mill of the revolving type; but so far as I know only one serious effort has been made to incorporate with this feature others of equal importance. The machine to be described — a Western invention that has recently passed the experimental stage—is known as the Rexman mill, the credit for its design and development being due to H. S. Rexworthy and J. F. Behneman. It is manufactured by the Joshua Hendy Iron Works, San Francisco, Cal. I recently inspected it in operation and recognized that it possesses several distinctive characteristics that invite comment, features that will arouse the interest of millmen and engineers, particularly those who are concerned with the economical reduction of ores prior to amalgamation or table concentration.

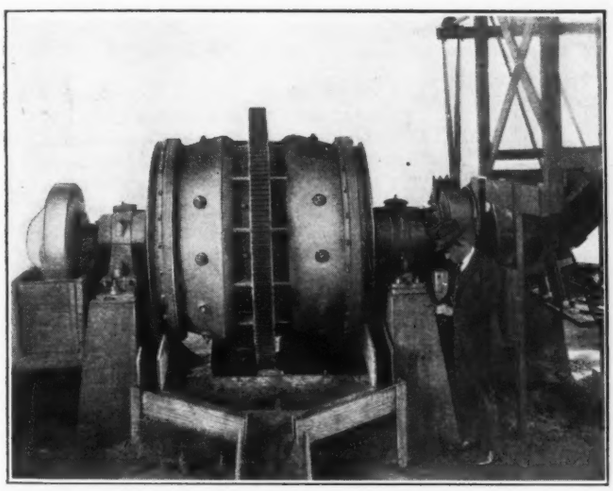


Fig. 1. Rexman mill, assembled and in operating position

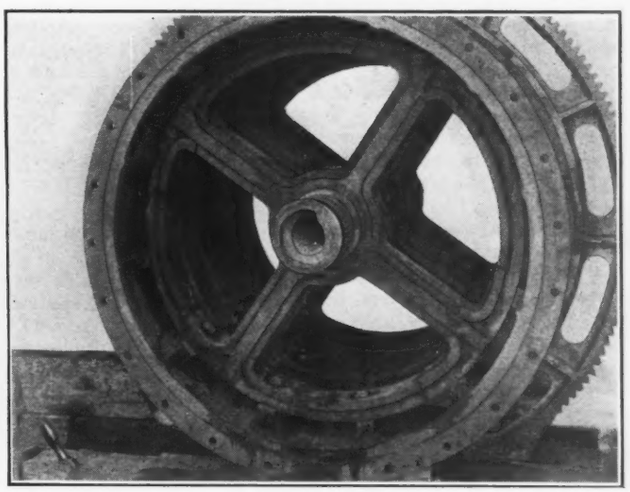


Fig. 2. Spider of Rexman mill, showing liners in place

A general idea of the design of the mill can be obtained by referring to the accompanying halftones and line drawing. The feed, of usual ball- or rod-mill size, together with an amount of diluent that reminds one of stamp-mill practice, is picked up at one or

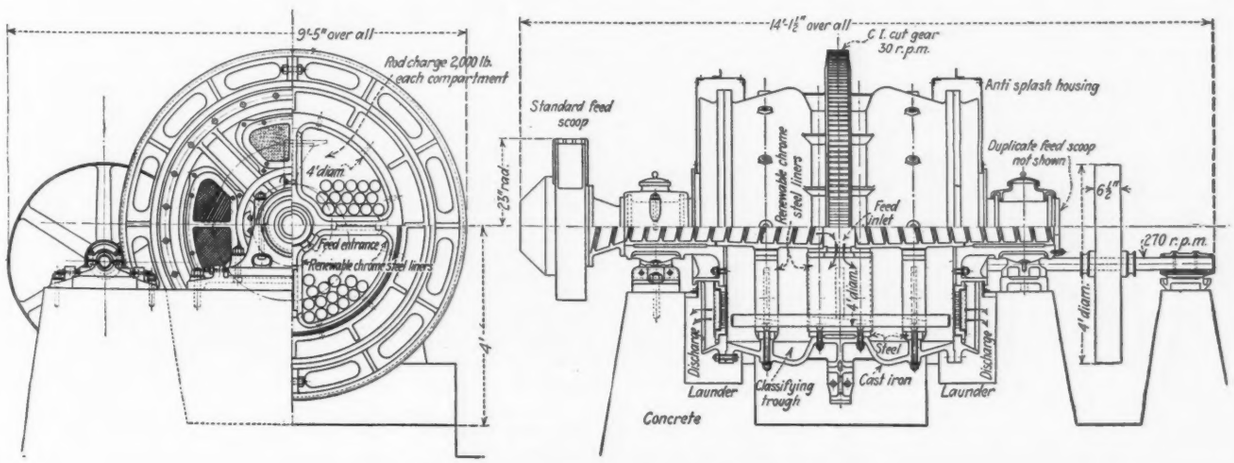


Fig. 3. The Rexman balanced rod mill

both ends of the mill by the usual type of feeder. The pulp is then passed, by means of a delivery tube with spiral liner, to the center of the mill—to a chamber with outlets to four compartments. These compartments, as shown in Figs. 2 and 3, are distinct only in so far as the rod load is concerned. The ore pulp is free to pass into any part of the interior of the mill, but the crushing rods are separated into four distinct bunches by a spider that is protected with appropriate liners. The rods impinge against the mill proper at three points, two comparatively narrow liners supporting them at a short distance from the ends of the mill and one comparatively broad liner taking the weight in the center.

The pulp discharges from the distributing chamber on to and between the falling rods, the revolution of the mill insuring fracture and abrasion in the ordinary way, except that impact is the predominating action. One of the most important features of the mill is that the rods maintain a horizontal position, parallel to one another, at all times. This is the result of central feeding, which insures an even distribution of pulp. The tilting of the rods, usual in the ordinary type of mill, is avoided.

The ore as crushed passes to the bottom of the mill, beyond the rods and away from further and unnecessary comminution, where duplicate troughs are provided with lifter partitions at intervals; these troughs are shaped to insure some measure of classifying action. The finer material is carried by the flow of water toward the two ends of the mill, at each of which is arranged a series of four grizzly screens, to protect the finer punched or woven screens used for final separation. The oversize from the fine screens passes back into the mill for further reduction. The splash from the discharge openings is deflected into a launder by means of a light metal hood, which can be removed when required, thus permitting inspection of the screens, or, if necessary, of the interior of the mill.

Characteristic Features of the Rexman Mill

The width of the pulley shown in Fig. 3, as compared with the size and ruggedness of the mill, is indicative of the small amount of power required. As a matter of fact, the extra load at starting is negligible; no clutch is necessary; direct belt connection with the motor is feasible. Shafting, spur gear, and pinion are proportionately small in size and light in weight.

The ability to feed into the mill through two scoops permits a further refinement in balancing and allows the passage of a large tonnage of ore for reduction in size through a small ratio —the most economical method of crushing. Many failures with cylindrical mills have been due to an inability to deliver the required tonnage through a trunnion of normal diameter; other disappointments have resulted from an attempt to achieve too extensive a reduction in particle size during one passage through the machine.

The center delivery of pulp in the Rexman mill is significant, for it halves the distance between feed and discharge points, thus preventing much of the unnecessary grinding that occurs in cylindrical mills equipped with trunnion feed at one end, and with trunnion or open discharge at the other end.

The ability to make all renewals and repairs and to add rods to the interior of the mill through the openings provided essentially for the screen frames does away with the necessity for a manhole in the shell. This permits the placing of the spur wheel centrally—another refinement in balancing. The pinion engages the spur wheel at a point where no splashing from pulp is possible. The advantage of this is obvious.

The wear on rods has not been determined. Suffice to say that, after the passage of about 1,200 tons of rock through the machine, I could detect no signs of extra abrasion at the points where the rods impinge against the cradle liners. I predict that the wear of rod on rod may be slightly in excess of what it is in an ordinary cylindrical mill, in which the blows of the grinding media are cushioned by the thick pulp in all parts. Against this, however, the Rexman mill must be credited with the added efficiency resulting from the prompt discharge of material already ground sufficiently fine. It is also apparent that a saving in liner wear will result because of the fact that the amount of wearing surface exposed to abrasive action is at a minimum, in proportion to the weight of the rods.

A large number of tests on rock have been made, and the following data are typical:

Size of mill, 4 ft. diameter by 4 ft. 6 in. long.
Weight of mill, 19,400 lb.
Rod load, 8,562 lb.
Diameter of rods, 2½, 2¾ and 3 in.
Speed of mill, 36 r.p.m.
Size of feed, —½ +⅜ in.
Width of openings in punched screen, $\frac{1}{16}$ x 2 in.
Character of feed, granite.
Ratio of water to dry feed, 2 to 1.
Quantity crushed, 182.4 tons per twenty-four hours.

The average power consumption during operations with full pulp load is from 19½ to 21 hp., or only about 2½ hp. in excess of that required for movement at normal speed and rod load but without pulp feed.

Owing to the positive classifying and screening actions in the mill, the new machine should find especial application in those instances where a graded product is desired and where unnecessary comminution should be avoided. Owing to the freedom with which ore constituents such as pyritic concentrate and free gold can escape between the rods and out of the mill, without slimming in the one case or flouring in the other, the machine should find favor with stamp-mill operators who are looking for a more self-contained unit, one that will give a screened product and consume power in proportion to the work done. In the crushing of a gold ore I see no reason why the design of the classifying troughs should not be modified so that they could be made to act as amalgamators.

For the preparation of an ore for table concentration, the Rexman mill would seem to possess many attractive features, without the disadvantages of high power requirements and lack of ability to regulate closely the character of the ultimate product other than by methods involving external classification. One important point about the new machine is worthy of emphasis: it seems probably that it can be manufactured at a cost appreciably below that of the ordinary mill of the same size.

With an intimate knowledge of the operation of the original type of wet-crushing, screening, cylindrical mill, I am inclined to think that the arrangement for screening the product and returning the oversize constitutes a weak feature. It seems probable that better work could be done if provision were made so that the oversize reject from the final screens were bypassed into the mill by some channel other than by the one only available for the delivery of the mixed pulp to the screens. The provision of such a bypass was a characteristic feature of the early Krupp mill and added greatly to its effectiveness.

For the present, the Rexman mill has been designed to operate with an ample flow of diluent; it is not an all-sliming mill, nor could it be adapted for such work without modification in design. However, it is probable that the main idea embodied in the present mill will be used at a later date to evolve another of the same type, but provided for the direct discharge of ground pulp.

A New Automatic Sampler

Every ore-dressing plant of importance has some means for sampling the pulp at various stages of the process. This can be done neatly and automatically by a recently invented machine which is adapted to cut out a representative sample from a stream of either wet or dry material as it flows out of a launder or other conveyor. It is only necessary to adjust the driving mechanism to secure the sampling interval desired. The drive may be either by means of a pulley and belt from a convenient line of shafting, or a ¼-hp. motor and housed-in worm-gear drive mounted as a unit to the frame may be employed. Either method is superior to the water-tipping box often used. The belt-driven machine sells complete, including the sample cutter, for $115, and the motor-driven apparatus for $165, the Galigher Machinery Co., Salt Lake City, Utah, being the manufacturers.